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**Phase III Ground Water Assessment
Burlington Industries, Inc.
Raeford Facility
Raeford, North Carolina**

April 2, 1992

Prepared For

**Burlington Industries, Inc.
Clarksville, Virginia**

Prepared By

**Aquaterra, Inc.
Charlotte, North Carolina**



AQUATERRA

Environmental Consultants

April 2, 1992

Mr. Michael Garlick
Burlington Industries, Inc.
Division Engineering
Post Office Box 788
Clarksville, Virginia 23927

Reference: Phase III Confirmation Ground Water Assessment,
Burlington Industries, Inc.
Raeford Facility
Raeford, North Carolina
Aquaterra Job No. C467
Number DE-1006-BM

Dear Mr. Garlick:

Aquaterra, Inc. (Aquaterra) has conducted the authorized Phase III confirmatory ground water assessment at the Burlington Industries, Inc. facility located in Raeford, North Carolina. The attached report summarizes our field activities, the laboratory analytical data, and presents our conclusions and recommendations.

The additional site assessment activities included sampling the three newly installed shallow monitoring wells and one newly installed deep well hydraulically downgradient of the wastewater retention basin. Subsequent to their installation, the monitoring wells were developed and sampled to determine the shallow ground water quality. In addition, existing monitoring wells MW-5i, MW-6i and MW-7 were purged and sampled. The samples from the previous wells and newly installed wells were analyzed for purgeable volatile organic compounds (VOCs). Rising head hydraulic conductivity tests were also conducted on each newly installed well to evaluate the approximate hydraulic conductivity of the well-screen interval. The wells were surveyed for vertical and horizontal control, and static water levels were also collected at all wells to estimate the general ground water flow direction at the site.

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Based upon these findings, Aquaterra would recommend that:

- the commercial pumping wells possibly effecting the water level readings at MW-6s be tested for VOCs,
- a remedial action plan (RAP) be developed to restore the ground water at the site, and
- the results from these investigations be submitted to the Fayetteville Regional DEM office for their review.

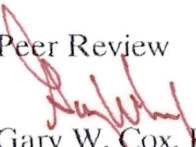
If you have any questions or comments, please contact Gary Cox at (704) 525-8680.

Sincerely,

AQUATERRA, INC.


Drew Duncklee
Senior Environmental Technician

Peer Review


Gary W. Cox, P. G.
Branch Manager

R274-92C
DD/GWC/rap

**Phase III Ground Water Assessment
Burlington Industries, Inc.
Raeford Facility
Raeford, North Carolina
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1 Introduction

1.1 *Underground Storage Tank Closure Activities*

Burlington Industries, Inc. (Burlington) owns and operates a yarn dye plant located in Raeford, North Carolina (see Figure 1). During March 1990, a 1,000 gallon mineral spirits (Safety Kleen) UST was excavated and removed. The UST closure is documented in the April 2, 1990 Aquaterra report titled *Underground Storage Tank Closure Assessment* (Aquaterra Report Number GR-28-90). Based on the laboratory analytical results from the UST closure sampling, elevated levels of volatile organic compounds (VOCs) contamination were detected in the soil samples from the Safety Kleen UST pit (see Figure 2 for former UST location). During April 1990, Burlington submitted a copy of the UST closure assessment report to the North Carolina Department of Environment, Health, and Natural Resources (DEHNR), Division of Environmental Management (DEM), Fayetteville, North Carolina regional office.

1.2 *Phase I Ground Water Assessment Activities*

Based on the results of the UST closure assessment report, the DEM requested that Burlington assess the ground water at the UST site for possible VOC related contamination. During November 1990, an Aquaterra geologist supervised the installation of three shallow ground water monitoring wells in the area of the former Safety Kleen UST excavation (see Figure 2, MW-4, MW-5, and MW-6). Laboratory results of monitoring well sampling indicated ground water contamination by chlorobenzene, dichlorobenzenes, 1,2,4-trichlorobenzene, 1,1-dichloroethane, and semivolatile tentatively identified compounds (TICs). During February 1991, Burlington submitted a report to the DEM summarizing the results of the investigation (*Phase I Ground Water Assessment*, Aquaterra Report Number R164-91C).

1.3 *April 1991 DEM Correspondence to Burlington*

Based upon their review of the Phase I ground water assessment report, DEM requested in an April 23, 1991 correspondence to Burlington that additional ground water assessment activities be conducted at the site.

1.4 *Phase II Ground Water Assessment Activities*

During July 1991, one hydraulically downgradient shallow ground water monitoring well (MW-7) and two 35-foot deep vertical assessment wells (MW-5i and MW-6i) were installed at the site (see Figure 2). Subsequent to installation, the newly installed monitoring wells were sampled for VOCs. Laboratory analytical results for monitoring well MW-7 indicated that shallow ground water downgradient of the former UST location was impacted by 1,1-dichloroethane, and cis-1,2-

Dichloroethene (see Table 3). Laboratory analytical results for the intermediate depth monitoring wells MW-5i and MW-6i indicated that deeper ground water was impacted by chloromethane (MW-6i at 2 $\mu\text{g/L}$), 1,1-dichloroethene (MW-5i at 15 $\mu\text{g/L}$ and MW-6i at 2 $\mu\text{g/L}$), 1,1-dichloroethane (MW-5i at 7 $\mu\text{g/L}$ and MW-6i at 2 $\mu\text{g/L}$), chloroform (MW-5i at 5 $\mu\text{g/L}$), and 1,1,1-trichloroethane (MW-6i at 1 $\mu\text{g/L}$). During September 1991, Burlington submitted a report to the DEM summarizing the results of the Phase II investigation (*Phase II Ground Water Assessment*, Aquaterra Report Number R230-91C).

1.5 September 1991 DEM Correspondence to Burlington

On September 27, 1991, the DEM responded by letter to Burlington regarding the Phase II report and requested that a comprehensive site assessment (CSA) be conducted to delineate the lateral and vertical extent of contamination (see Attachment A).

2 Scope of Work

Subsequent to receipt of the September 1991 correspondence from DEM, Mr. Mike Garlick of Burlington contacted Mr. Stephen Barnhardt of the DEM. Based on Burlington's subsequent correspondence to DEM (see Attachment B), and Aquaterra's telephone conversations with Mr. Garlick of Burlington, several additional site assessment activities were initiated. These activities are detailed in our October 22, 1991 and November 22, 1991 proposals to Burlington. The scope of work of those proposals are summarized below:

- resample monitoring wells MW-5i, MW-6i, and MW-7 for VOCs
- install and sample three additional shallow monitoring wells (MW-8, MW-9, and MW-10, see Figure 2)
- install and sample one 75-foot deep vertical assessment well (MW-6d, see Figure 2)
- collect static water levels from all monitoring wells at the site to verify the ground water flow direction
- conduct a search of DEM files in Fayetteville, North Carolina to obtain information on Raeford area drinking water wells, boring logs, and/or any information pertaining to a soil confining layer
- locate drinking water wells within 1,500 feet the former Safety Kleen UST site
- prepare a report summarizing the information obtained and laboratory results reported

The following report details the field activities and laboratory analytical results of the assessment efforts conducted at the site during late 1991 and early 1992.

3 Monitoring Well Confirmatory Sampling Activities

3.1 Ground Water Sampling

An Aquaterra environmental technician conducted confirmatory ground water sampling of monitoring wells MW-5i, MW-6i, and MW-7 on October 31, 1991. Prior to conducting the sampling the technician measured the depth to water at each monitoring well. An assigned laboratory decontaminated Teflon bailer was then used to remove approximately three well volumes from each well.

To sample the wells, the assigned Teflon bailer was used to gently decant the ground water into laboratory provided glassware. The samples were labeled with their respective well number, date, time, analysis to be conducted, and sampler's name. Each sample was placed in an ice-filled cooler, chilled to approximately 4°C, and transported to the analytical laboratory using EPA approved chain-of-custody procedures to ensure sample integrity. At the laboratory, monitoring well samples MW-5i, MW-6i, and MW-7 were analyzed for VOCs according to EPA Method 601.

3.2 Ground Water Sample Analysis

All three monitoring wells exhibited VOCs above the North Carolina ground water standards (NCAC T15:02L.0202) (see Table 3 and Attachment C). The results are summarized as follows:

The following compounds exceeding standards were detected in MW-5i:

- 1,1-Dichloroethene (32 ug/L)
- 1,1-Dichloroethane (21 ug/L)
- Chloroform (2)ug/L
- Carbon Tetrachloride (2 µg/L)
- 1,2-Dichlorobenzene (1 µg/L)

The following compounds exceeding standards were detected in MW-6i:

- 1,1-Dichloroethene (18 µg/L)
- Chloroform (1 µg/L)
- 1,2 Dichloroethane (3 µg/L)
- Tetrachloroethene (1 µg/L)
- 1,2 Dichlorobenzene (6 µg/L)
- 1,4 Dichlorobenzene (17 µg/L)

The following compounds exceeding standards were detected in MW-7:

- 1,1-Dichloroethane (4 µg/L)
- 1,2 Dichlorobenzene (1 µg/L)
- 1,3-Dichlorobenzene (2 µg/L)
- 1,4-Dichlorobenzene (7 µg/L)

4 Additional Ground Water Assessment Activities

4.1 *Shallow Monitoring Well Installation*

From January 13 through 15, 1992, an Aquaterra environmental technician and drillers from Carolina Drilling of Wilmington, North Carolina installed three shallow ground water monitoring wells MW-8, MW-9, and MW-10 (see Figure 2 for well locations). MW-8, MW-9, and MW-10 were installed by using a hollow stem auger rig to advance an approximately 8-inch boring to approximately 25 feet, and MW-8 to approximately 28.5 feet below grade. During the boring, split spoon samples and cuttings were collected and scanned for emissions of volatilized organic compounds (VOCs) using an organic vapor analyzer (OVA) (see Attachment D for boring logs). The split spoon samples, collected at 5-foot intervals, and the drill cuttings were logged in the field according to the Unified Soil Classification System (ASTM D-2488).

When the well borings were terminated, a ground water monitoring well was constructed by installing a 2-inch diameter PVC casing and screen inside each boring. The annular space around the screened interval was backfilled with filter sand to approximately 1 to 2 feet above the top of the screen, and an approximately 2-foot thick hydrated bentonite seal was constructed above the filter pack. The remaining annular space was grouted to the surface using Portland #1 cement. A flush-grade well cover, watertight well cap and lock were installed at the wellhead (see Attachment D for well construction information). After completing well installation, the shallow ground water was allowed to equilibrate.

4.2 *Deep Monitoring Well Installation*

Monitoring well MW-6d was installed in a similar manner as described above. However, a 9-inch diameter boring was advanced to approximately 48 feet below grade, and an approximately 6-inch diameter outer PVC casing was grouted in-place. Then, after the grout had hardened, a 4-inch diameter boring was advanced inside the outer casing through the grout and into the soil to a total depth of approximately 76 feet below grade (see Attachment D for boring log). The monitoring well was then constructed by installing a 2-inch diameter PVC casing and screen inside each boring. The annular space around the screened interval was backfilled with filter sand to approximately 1 to 2 feet above the top of the screen, and an approximately 2-foot thick hydrated bentonite seal was constructed above the filter pack. The remaining annular space was grouted to the surface using Portland #1 cement. A flush-grade well cover, watertight well cap and lock were installed at the wellhead (see Attachment D for well construction information). After completing well installation, the ground water was allowed to equilibrate.

4.3 *Surveying and Ground Water Flow Direction*

The monitoring wells were surveyed by Aquaterra personnel for vertical and horizontal control relative to the existing wells at the site. Aquaterra collected two rounds of depth to water measurements on February 13 and March 9, 1992, for all monitoring wells in the former Safety Kleen UST area. These data and the depth to water measurements in each well have been used to calculate the static water level elevation at each well location (see Table 1 and 2). From these elevations, two ground water contour maps have been constructed for the shallow ground water in the vicinity of the UST system (see Figures 3 and 4). On February 13, 1992 (see Figure 3), the shallow ground water was migrating in a northeasterly direction in the former Safety Kleen UST area at an approximate gradient of 0.022 ft/ft. On March 9, 1992, the shallow ground water was migrating in a northeasterly direction in the former Safety Kleen UST area at a similar gradient. A later round of static levels on March 16 and 17, 1992, resulted in an anomalous reading for MW-6s, indicating a zone of depression. Until further testing is completed to substantiate those levels, the information has not been tabularized for purposes of this report.

4.4 *Hydraulic Conductivity Testing*

Aquaterra conducted a rising head hydraulic conductivity test on the newly installed monitoring wells MW-6d, MW-8, MW-9, and MW-10 to determine the approximate hydraulic conductivity of the aquifer in the immediate vicinity of the wells (see Attachment E for field data and calculations). The test consists of bailing a measured volume of water from the well and then measuring the rate of ground water recovery. Using the methods discussed in *Field Permeability Test Methods with Applications to Solution Mining*, published by the U.S. Bureau of Mines (PB-272 452, August 1977), the following are the hydraulic conductivity of the soils across the screened interval at the four well locations:

<u>Well Number</u>	<u>Hydraulic Conductivity (cm/sec)</u>
MW-6d	**
MW-8	3.90×10^{-4}
MW-9	3.59×10^{-4}
MW-10	9.39×10^{-4}

** Test not completed due to rapid recovery

The hydraulic gradient across the newly installed wells is approximately 0.022 foot per foot, and the shallow ground water seepage velocity in the vicinity of the facility is ranging from approximately 9 to 30 feet per year. This value should be recognized as an average value for the study area. For consistency in using past data, an effective porosity of .20 was used in calculating seepage velocity. Actual seepage velocities in the hydrogeologic unit are likely to vary due to heterogeneities in the aquifer.

4.5 *Ground Water Sampling and Analysis*

4.5.1 *Ground Water Sampling*

On January 16, 1992, an Aquaterra environmental technician conducted ground water sampling on monitoring wells MW-6d, MW-8, MW-9, and MW-10. A laboratory decontaminated Teflon bailer was then used to remove approximately five well volumes (to develop and remove fine silts) from each well. On February 13, 1992, an Aquaterra environmental technician conducted confirmatory ground water sampling of monitoring wells MW-6d and MW-9. Prior to conducting the sampling, the technician measured the depth to water at each monitoring well (see Table 1). A second set of water levels was collected on March 9, 1992 (see Table 2). To sample the wells, the Teflon bailer was used to gently decant the ground water into laboratory provided glassware. The samples were labeled with their respective well number, date, time, analysis to be conducted, and sampler's name. Each sample was placed in an ice-filled cooler, chilled to approximately 4°C, and transported to the analytical laboratory using EPA approved chain-of-custody procedures to ensure sample integrity. At the laboratory, monitoring well samples MW-6d, MW-8, MW-9, and MW-10 were analyzed for VOCs according to EPA Method 601 (see Table 4 and Attachment F for sample result documentation).

4.5.2 *Ground Water Sample Analysis*

The analytical results from the January sampling event indicated no purgeable halocarbons compounds above the laboratory detection limit for MW-8 and MW-10 (see Table 4 and Attachment C). Only monitoring wells MW-6d and MW-9 were sampled during the February sampling event. The following compounds exceeding North Carolina ground water standards were found in the following during the two sampling events:

The following compounds were detected in MW-6d:

- 1,1-Dichloroethene (4.7 and 7 µg/L).
- 1,1-Dichloroethane (4.5 to 7 µg/L)
- Chloroform (1.42)
- Carbon tetrachloride (9.9 to 13 µg/L)
- 1,4-Dichlorobenzene 2 µg/L

The following compounds were detected in MW-9:

- 1,2 Dichlorobenzene (1 µg/L)
- 1,3 Dichlorobenzene (2 µg/L)
- 1,3 Dichlorobenzene (15 µg/L)
- 1,1-Dichloroethane (2.64 and 4 µg/L).
- cis-Dichloroethene (2 µg/L)
- Tetrachloroethene (2.36 and 3 µg/L)

5 DEM File Search /Private Wells/Boring Logs

On October 30, 1991, an Aquaterra environmental technician conducted a file search at the regional Department of Environmental Management (DEM) in Fayetteville, North Carolina. The files were searched for any records regarding installations of drinking water wells or boring logs in the general vicinity of the Burlington plant. The technician found record of one drinking water well installed at the Highway Equipment Yard in 1972 approximately 2,000 feet from the nearest monitoring well (see Figure 5). A subsurface boring log was also available for the above well (see Attachment G). A drive-by investigation was performed by the technician to inspect whether any additional drinking water wells were present around the site. The technician visually noted that seven drinking water wells were within a 0.5 mile radius of the site, including the drinking water well located in the DEM files.

Aquaterra also searched for any drinking water wells within a 1,500-foot radius of the former Safety Kleen UST area. No drinking water wells were found within this area. However, two Burlington owned commercial wells produce approximately 150 to 300 gallons of water per minute within the 1,500-foot radius.

6 Confining Layers

A review of the boring log for the Highway Equipment Yard well was not successful in depicting a clearly recognized regional confining layer (see Attachment G). The log describes multiple alternating lenses of sand and clay, variable in thickness, color, and heterogeneity. The more common lithology recorded for the upper 50 feet (the interval of interest to this study) is red clay with sand streaks. Although a distinct confining bed is not apparent, the alternating character of sand and clay suggest that at least locally, downward migration of ground water would be restricted to some degree by the presence of those clay units, one of which is apparently greater than 10 feet thick. From the Aquaterra log for MW-6d, drilled to 76 feet, a similar sequence of silty to sandy clay is described. One unit at 44 feet to 48 feet in depth is described as a brick red clay which is much more dense than associated units. This unit, if persistent throughout the area of investigation, would likely exhibit some retardation of downward vertical ground water flow.

7 Conclusions

Aquaterra has installed three additional shallow ground water monitoring well, and one vertical assessment monitoring well at the site. The newly installed wells were sampled for VOCs. Based on the field assessment activities, the laboratory analytical results, and our experiences at similar sites, we conclude the following:

- Based upon the shallow ground water flow map for 2-13-92 and 3-9-92, the shallow ground water flow is to the northeast, consistent with findings of previous phases of investigation. Ground water flow velocity is estimated to range from 9 to 30 feet per year.

- An anomalous set of static water levels on 3-16-92 and 3-17-92 for MW-6s may suggest an hydraulic influence from the commercial pumping wells on-site. This observation will require confirmation by additional testing at some future date.
- Ground water quality results for MW-5i, MW-6i, and MW-7 (confirmatory 10-31-91 results) reported VOCs in all three wells. For MW-5i, the compounds which exceed North Carolina ground water quality standards (Title 15, Subchapter 2L Section .0202) are:

1,1-Dichloroethene (32 $\mu\text{g/L}$)
1,1-Dichloroethane (2 $\mu\text{g/L}$)
Chloroform (2 $\mu\text{g/L}$)
Carbon tetrachloride (2 $\mu\text{g/L}$)
1,2-Dichlorobenzene (1 $\mu\text{g/L}$)

For MW-6i, the compounds which exceed ground water quality standards are:

1,1-Dichloroethene (18 $\mu\text{g/L}$)
Chloroform (1 $\mu\text{g/L}$)
1,2-Dichloroethane (3 $\mu\text{g/L}$)
Tetrachloroethene (1 $\mu\text{g/L}$)
1,2-Dichlorobenzene (6 $\mu\text{g/L}$)
1,4-Dichlorobenzene (17 $\mu\text{g/L}$)

For MW-7, the compounds which exceed ground water quality standards are:

1,1-Dichloroethane (4 $\mu\text{g/L}$)
1,2-Dichlorobenzene (1 $\mu\text{g/L}$)
1,3-Dichlorobenzene (2 $\mu\text{g/L}$)
1,4-Dichlorobenzene (7 $\mu\text{g/L}$)

None of the above compounds for any of the well samples are substantially elevated above standard limits. The majority of the compounds are either only slightly elevated with respect to standards, or are listed due to the absence of established standards, in which case any detectable concentrations are considered in violations of North Carolina ground water quality standards.

- Ground water quality results reported for the three new shallow well installations (MW-8, MW-9 and MW-10) and the vertical well (MW-6d) confirm that ground water quality downgradient of both the former Safety Kleen UST and the retention pond is impacted by low $\mu\text{g/L}$ concentrations of VOCs. Only monitoring wells MW-6d and MW-9 were sampled during the February sampling event. The following exceedences of NC ground water standards were found in the following during the two sampling events:

The following compound concentrations exceeding standards were detected in MW-6d:

- 1,1-Dichloroethene (4.7 and 7 $\mu\text{g/L}$).
- 1,1-Dichloroethane (4.5 to 7 $\mu\text{g/L}$)
- Chloroform (1.42)
- Carbon tetrachloride (9.9 to 13 $\mu\text{g/L}$)
- 1,4-Dichlorobenzene (2 $\mu\text{g/L}$)

The following compounds concentrations exceeding standards were detected in MW-9:

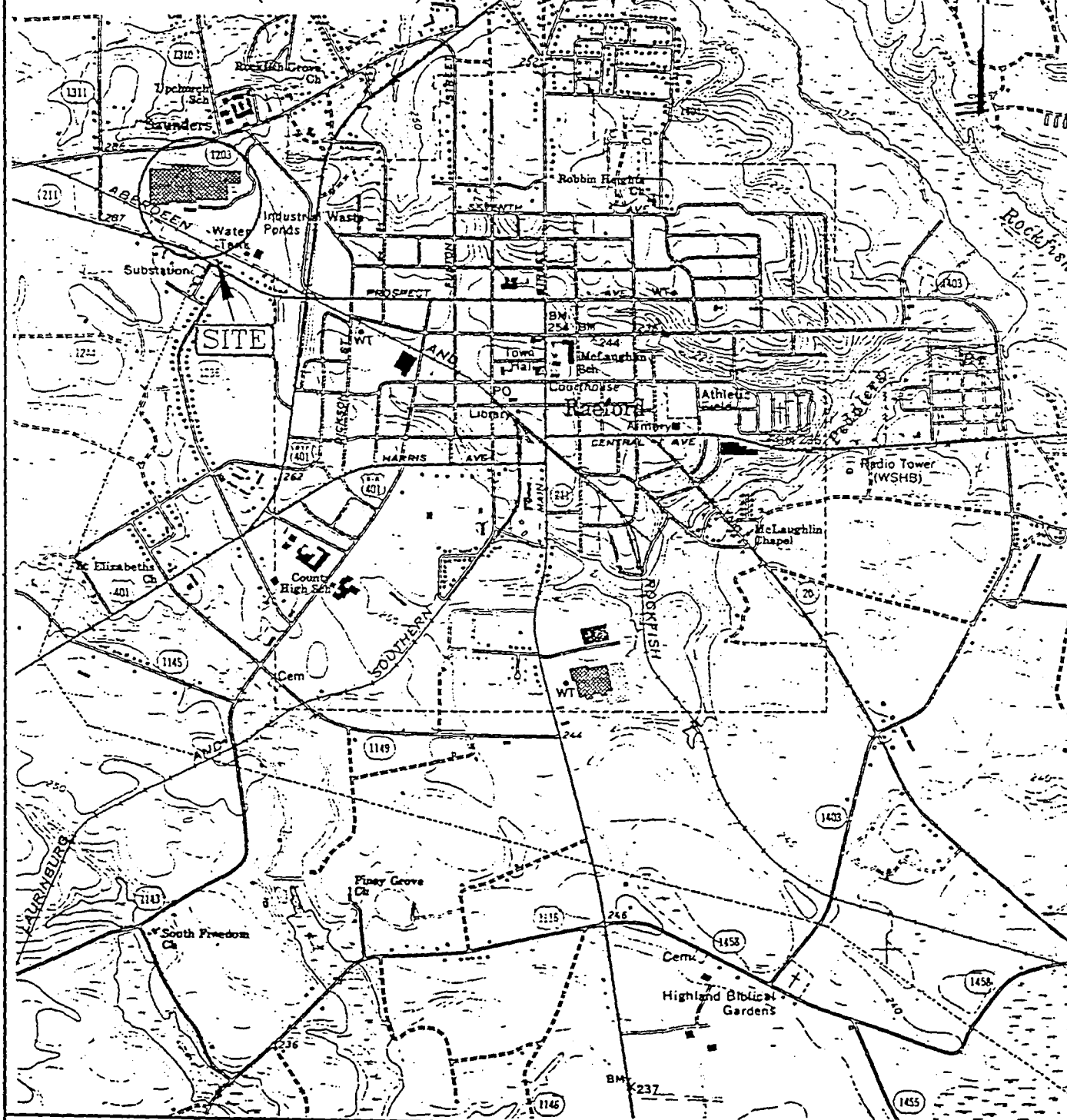
- 1,2 Dichlorobenzene (1 $\mu\text{g/L}$)
- 1,3 Dichlorobenzene (2 $\mu\text{g/L}$)
- 1,3 Dichlorobenzene (15 $\mu\text{g/L}$)
- 1,1-Dichloroethane (2.64 and 4 $\mu\text{g/L}$).
- cis-Dichloroethene (2 $\mu\text{g/L}$)
- Tetrachloroethene (2.36 and 3 $\mu\text{g/L}$)

None of the above compounds are substantially elevated with respect to their standards. The majority of compounds are only slightly evaluated or are listed because of the absence of an established standard, in which case any detectable quantity is in violation of the North Carolina ground water quality standards.

- The presence of carbon tetrachloride and 1,1,1-trichloroethane in the MW-6d well sample suggest the possibility of contaminant phase differentiation within the plume. Both of the above compounds have higher densities than water and tend to sink with response to gravity upon release into ground water. The general absence of these compounds in the shallow monitoring well samples and their presence in the deep well (MW-6d) sample is compatible with a dissolved dense phase component of the plume at depth. This correlation does not, however, exclude the possibility for mixed sources contributing to plume chemistry.
- Ground water quality for MW-8 and MW-10 (BQL for all tested VOC constituents) coupled with the low total VOCs found in well MW-9 (81 $\mu\text{g/L}$ total VOCs) sufficiently describe the shallow extent of VOC contamination. Also, the low-levels of total VOCs in well MW-6d (32 $\mu\text{g/L}$) are considered sufficient to describe the vertical extent of VOC contamination.



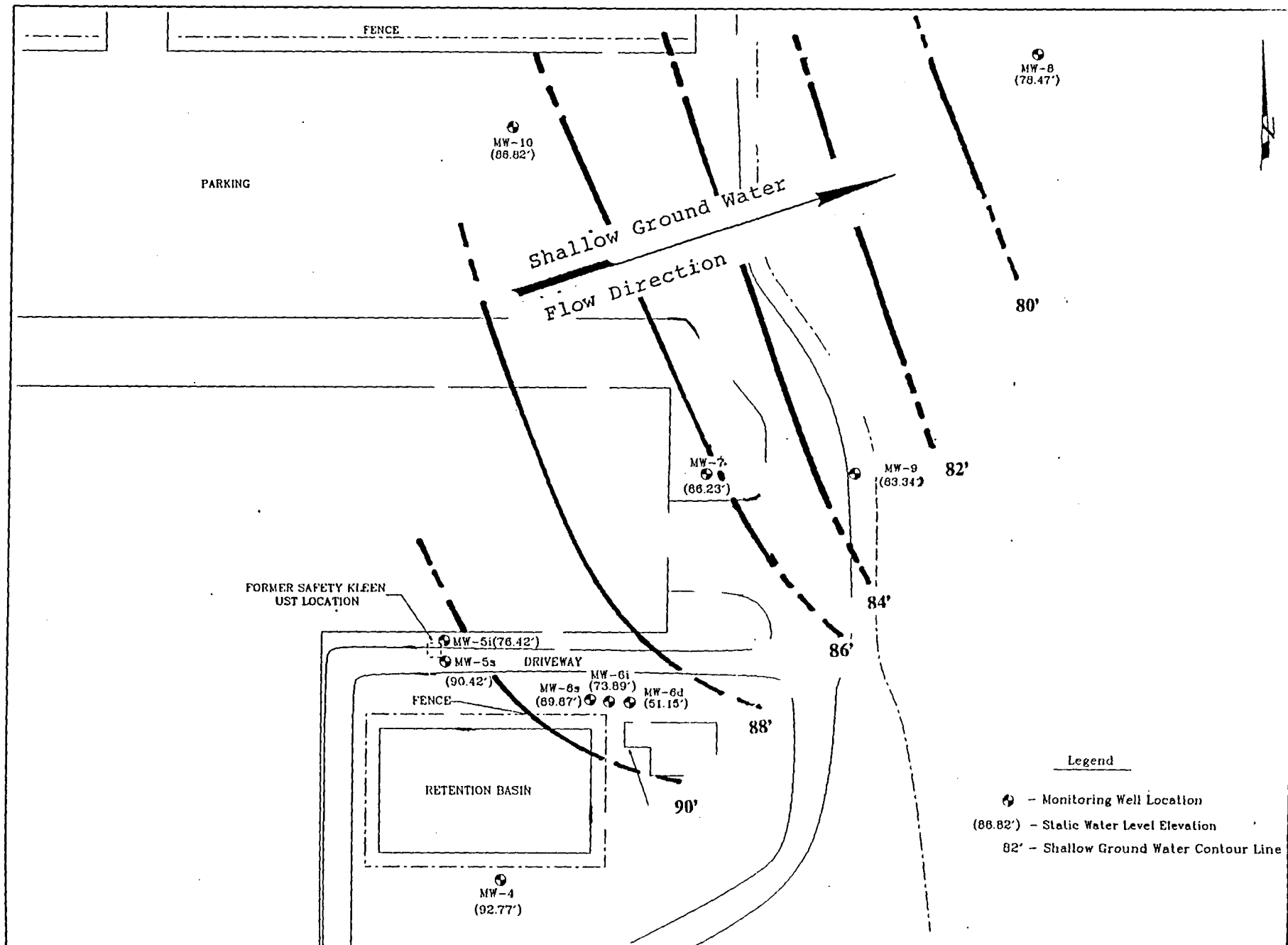
RAEFORD QUADRANGLE
NORTH CAROLINA
7.5 MINUTE SERIES (TOPOGRAPHIC) per City




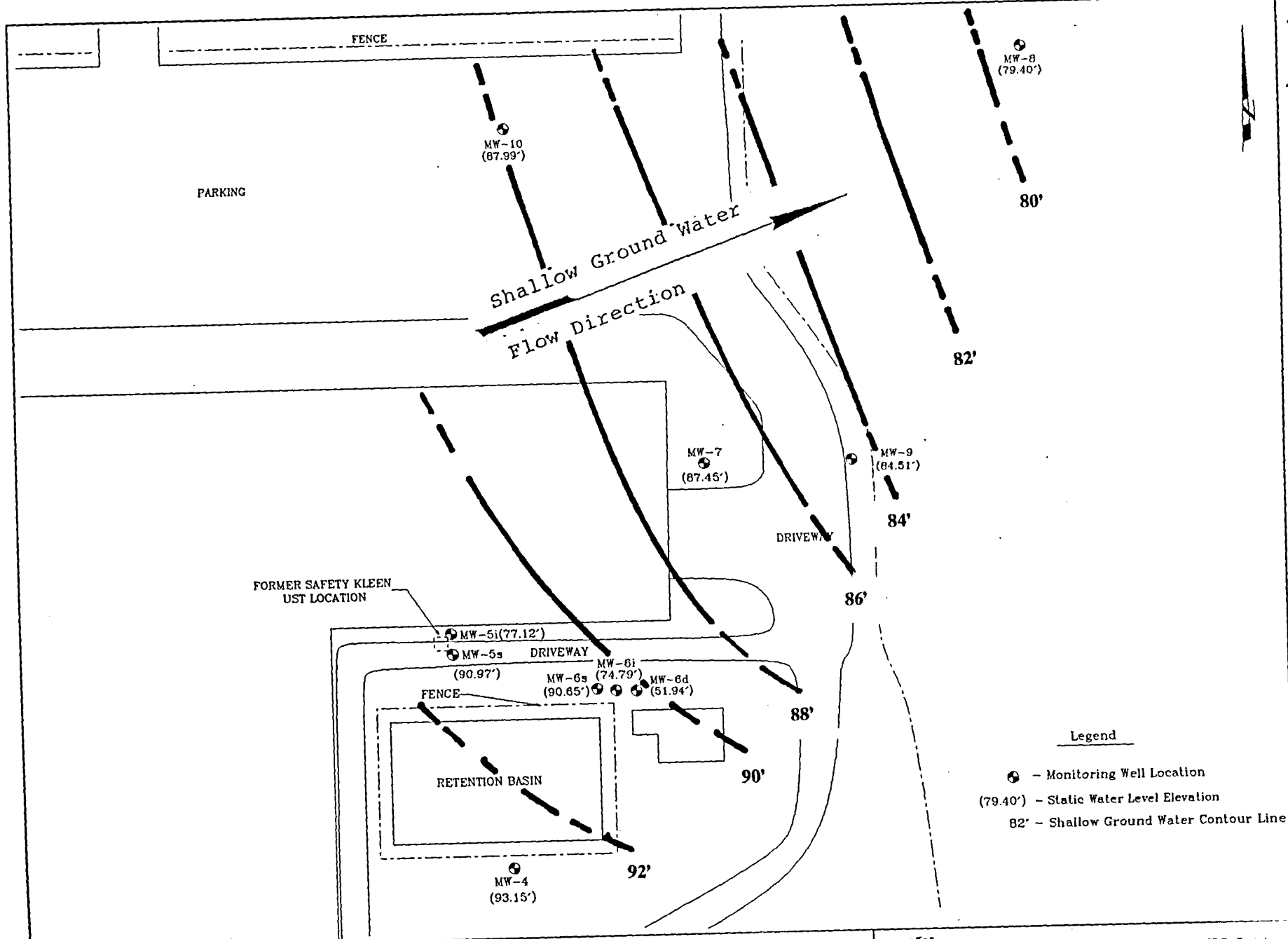
AQUATERRA, INC.
RALEIGH, GREENSBORO, CHARLOTTE
NORTH CAROLINA

Author HAT	Drawing	Layers	Date	Title Site Location
Job No. C-487	Revision	Figure 1	Scale 1"=2000'	Project Burlington Industries Raeford, North Carolina





PROJECT: BURLINGTON INDUSTRIES RAEFORD, NORTH CAROLINA	TITLE: GROUND WATER FLOW MAP				 AQUATERRA, INC. RALEIGH, GREENSBORO, CHARLOTTE NORTH CAROLINA
	JOB: 467C	DRAWING: 467C-2	FIGURE: 3	SCALE: 1"=100'	



Legend

- - Monitoring Well Location
- (79.40') - Static Water Level Elevation
- 82' - Shallow Ground Water Contour Line

PROJECT:

BURLINGTON INDUSTRIES
RAEFORD, NORTH CAROLINA

TITLE: GROUND WATER FLOW MAP

3-9-92

JOB:

467C

DRAWING:

467C-2

FIGURE:

4

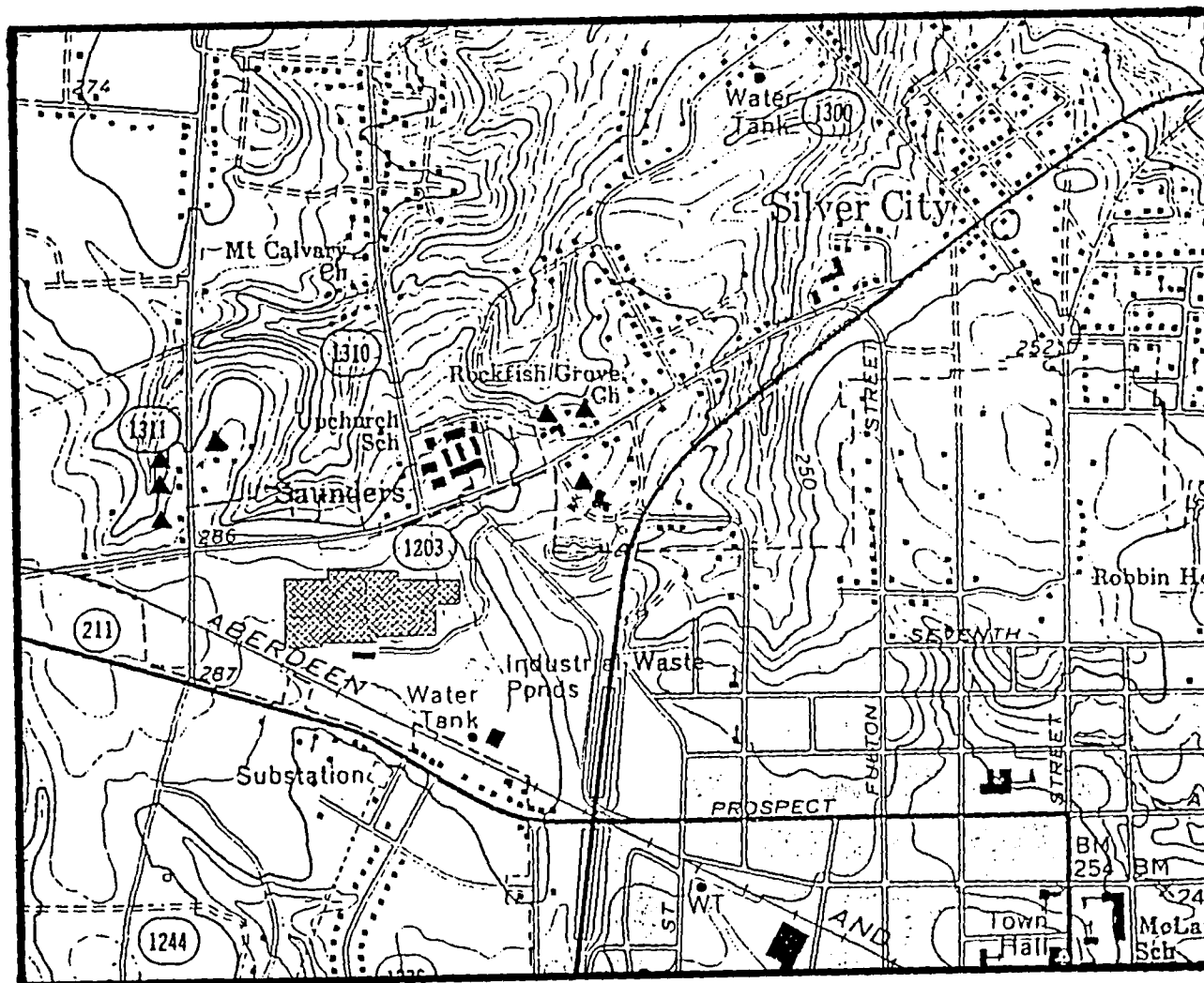
SCALE:

1"=100'



AQUATERRA, INC.

RALEIGH, GREENSBORO, CHARLOTTE
NORTH CAROLINA



Legend

▲ - Approximate Drinking Water Well Location

PROJECT:
BURLINGTON INDUSTRIES
RAEFORD, NORTH CAROLINA

TITLE: Drinking Water Well Location Map

JOB:
467C

DRAWING:
467C-2

FIGURE:
5

SCALE:
N/A



AQUATERRA, INC.
RALEIGH, GREENSBORO, CHARLOTTE
NORTH CAROLINA

Table 1. February 13, 1992 Static Water Level Elevation Data for Burlington Industries, Inc., Raeford, North Carolina, .

Well No.	TOCE (ft.)	DTW (ft.)	SWLE (ft.)
MW-4	99.35	6.58	92.77
MW-5s	100.17	9.75	90.42
MW-5i	100.37	23.91	76.46
MWR-6s	99.26	9.39	89.87
MW-6i	99.40	25.51	73.89
MW-6d	99.40	48.25	51.15
MW-7	99.98	13.75	86.23
MW-8	87.52	9.05	78.47
MW-9	96.32	12.98	83.34
MW-10	98.22	11.40	86.82

DTW Depth to water below top of casing

SWLE Static water level elevation

TOCE Top of casing relative elevation

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R274-92C

Table 2. March 9, 1992 Static Water Level Elevation Data for Burlington Industries, Inc., Raeford, North Carolina.

Well No.	TOCE (ft.)	DTW (ft.)	SWLE (ft.)
MW-4	99.35	6.20	93.15
MW-5s	100.17	9.20	90.97
MW-5i	100.37	23.25	77.12
MWR-6s	99.26	8.61	90.65
MW-6i	99.40	24.61	74.79
MW-6d	99.40	47.46	51.94
MW-7	99.98	12.53	87.45
MW-8	87.52	8.12	79.40
MW-9	96.32	11.81	84.51
MW-10	98.22	10.23	87.99

DTW Depth to water below top of casing

SWLE Static water level elevation

TOCE Top of casing relative elevation

*Aquaterra Job Number C467
R274-92C*

Table 3. Confirmatory Analytical Results for Monitoring Wells MW-5i, MW-6i, and MW-7, Burlington Industries, Inc., Raeford, North Carolina.

EPA 601 Compounds	North Carolina Ground Water Standards	7-12-91 MW-5i	10-31-91 MW-5i	7-12-91 MW-6i	10-31-91 MW-6i	7-12-91 MW-7	10-31-91 MW-7
<i>Purgeable Halocarbons</i>							
Chloromethane	LQL	BQL	BQL	2	BQL	BQL	BQL
Methylene Chloride	5	BQL	BQL	BQL	BQL	BQL	3
1,1-Dichloroethene	7	15	32	2	18	BQL	BQL
1,1-Dichloroethane	LQL	7	21	2	BQL	5	4
cis-1,2-Dichloroethene	LQL	BQL	BQL	BQL	BQL	2	BQL
Chloroform	0.19	5	2	BQL	1	BQL	BQL
1,2-Dichloroethane	.38	BQL	BQL	BQL	3	BQL	BQL
Carbon Tetrachloride	0.3	BQL	2	BQL	BQL	BQL	BQL
Bromodichloromethane	LQL	1	BQL	BQL	BQL	BQL	BQL
1,1,1-Trichloroethane	200	BQL	BQL	1	BQL	BQL	BQL
Trichloroethene	2.8	BQL	BQL	BQL	BQL	BQL	BQL
Tetrachloroethene	0.7	BQL	BQL	BQL	1	BQL	BQL
Chlorobenzene	300	BQL	2	BQL	13	BQL	43
1,2-Dichlorobenzene	LQL	BQL	1	BQL	6	BQL	1
1,3-Dichlorobenzene	LQL	BQL	BQL	BQL	BQL	BQL	2
1,4-Dichlorobenzene	LQL	BQL	BQL	BQL	17	BQL	7

All units in µg/L

LQL Not allowed in ground water above laboratory quantitation limit (NCAC T15:02L.0202).

BQL Below the Laboratory Quantitation Limit

Analytical Laboratory: Hydrologic, Inc.
Frankfort, Kentucky

Aquaterra Job No. C467
R274-92C

Table 4. Ground Water Analytical Results for Monitoring Wells MW-6d, MW-8, MW-9 and MW-10, Burlington Industries, Inc., Raeford, North Carolina.

EPA 601 Compounds	North Carolina Ground Water Standards	1-16-92 MW-6d	2-13-92 MW-6d	1-16-92 MW-8	1-16-92 MW-9	2-13-92 MW-9	1-16-92 MW-10
<i>Purgeable Halocarbons</i>							
1,1-Dichloroethene	7	4.7	7	BQL	0.6	1	BQL
1,1-Dichloroethane	LQL	4.5	7	BQL	2.64	4	BQL
cis-1,2-Dichloroethene	LQL	BQL	BQL	BQL	BQL	2	BQL
Chloroform	0.19	1.42	BQL	BQL	BQL	BQL	BQL
Carbon Tetrachloride	0.3	9.9	13	BQL	BQL	BQL	BQL
1,1,1-Trichloroethane	200	1.4	2	BQL	BQL	BQL	BQL
Trichloroethene	2.8	BQL	BQL	BQL	1.1	2	BQL
Tetrachloroethene	0.7	BQL	1	BQL	2.36	3	BQL
Chlorobenzene	300	BQL	BQL	BQL	22.1	51	BQL
1,2-Dichlorobenzene	LQL	BQL	BQL	BQL	BQL	1	BQL
1,3-Dichlorobenzene	LQL	BQL	BQL	BQL	0.74	2	BQL
1,4-Dichlorobenzene	LQL	BQL	2	BQL	6.15	15	BQL

All units in µg/L

LQL Not allowed in ground water above laboratory quantitation limit (NCAC T15:02L.0202).

BQL Below the Laboratory Quantitation Limit

*Analytical Laboratory: Hydrologic, Inc.
Frankfort, Kentucky*

Aquaterra Job No. C467



State of North Carolina
Department of Environment, Health, and Natural Resources
Fayetteville Regional Office

James G. Martin, Governor

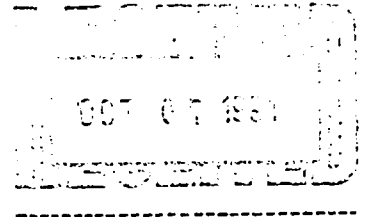
William W. Cobey, Jr., Secretary

DIVISION OF ENVIRONMENTAL MANAGEMENT

September 27, 1991

Mr. Mike Garlick
Burlington Menswear
Executives Offices
P.O. Box 788
Clarksville, VA 23927

SUBJECT: Groundwater Assessment
Burlington Industries
Raeford, Hoke County
Incident No. 5531



Dear Mr. Garlick:

The Fayetteville Regional Office has reviewed the assessment report by Aquaterra, Inc. at the Burlington Industries Raeford facility. Your consultant has not determined the vertical and horizontal extent of groundwater contamination nor the aquifer characteristics at the site.

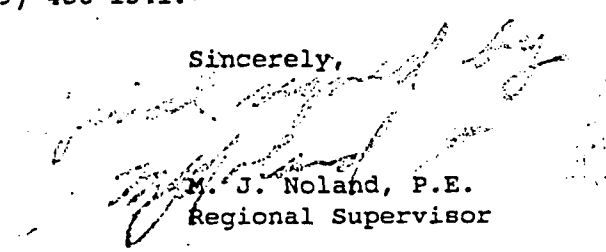
The Division requests a plan of action and proposed time schedule be submitted no later than 15 days of the receipt of this letter. The Division requires that a completed comprehensive site assessment be submitted no later than forty-five (45) days after the receipt of this letter unless another deadline is approved by the Fayetteville Regional Office.

Under the authority of G.S. 143-215.6A, failure to comply with this deadline could result in an enforcement action, with civil penalties not to exceed \$10,000 per day for each day of continued noncompliance.

Mr. Mike Garlick
Page 2
September 27, 1991

If you have any questions, please contact Mr. Stephen Barnhardt, L.G., or Mr. Jim Bales, L.G., at (919) 486-1541.

Sincerely,



P. J. Noland, P.E.
Regional Supervisor

MJN/SAB/rhg

cc: Aquaterra, Inc.

Burlington Menswear

October 14, 1991

A Division of Burlington Industries

Executives Offices

P.O. Box 788

Clarksville, Va. 23927

(804) 374-8111

State of North Carolina
DEHNR
Fayetteville Regional Office
Wachovia Building, Suite 714
Fayetteville, North Carolina 28301-5043

ATTN: M.J. Noland

RE: Groundwater Assessment
Burlington Industries
Raeford, Hoke County
Incident No. 5531

Dear Mr. Noland:

In response to your September 27, 1991 letter and several subsequent phone conversations with Mr. Stephen Barnhardt of the DEHNR, following please find a plan of action for additional assessment with a time schedule for completion of the referenced tasks.

Phase I - Confirmation Sampling and Literature Search:

- A. Re-sample monitor wells MW-5, MW-6, and MW-7 to verify the initial sampling results. (These are the newly installed wells.) The wells will be bailed several times and sampled for volatile organic compounds according to EPA Method 601.
- B. Perform a geology literature search to review existing data on soil borings from the immediate area. Also, provide information on nearby drinking water supply wells.
- C. Ground water flow measurements will be taken to verify previous data.



Groundwater Assessment
Burlington Industries
Raeford, Hoke County
Incident No. 5531
Page 2

Phase II - Install a Down-gradient Well and Perform a Soil Boring.

If the impact to ground water is confirmed, Burlington will proceed to Phase II.

- A. Install a down-gradient shallow monitoring well to aid in determining the horizontal extent of the ground water contamination. The well will be located down-gradient from MW-7 approximately 25' from the property line and sampled for volatile organic compounds according to EPA Method 601.
- B. If the geology literature search in Phase I is inadequate to determine a confining layer, then a soil boring will be made up-gradient to the contamination area. Split spoon samples will be taken during the boring to determine the presence and location of a confining layer.

The schedule for Phase I and Phase II work is as follows:

Phase I - Completion Date - 11/4/91
Phase II - Completion Date - 12/4/91
Report Completion and Submittal - 12/23/91

Burlington requests approval of the described plan of action and time schedule. Also, it is requested that the former Varsol UST area be considered closed since there were no ground water contaminants above the NC Class GA Ground Water Standards (7/12/91 sample on MW-3 submitted on 9/9/91).

If you have questions or comments concerning this information, please call me at 804-374-8111, extension 3514.

Sincerely,

G. Mike Garlick

G. Mike Garlick
Division Environmental Engineer

GMG/dr

cc: T. Fripp - BMEQ
M. Cowley - BMEQ
A. Allen - BMD
L. Nowell - Raeford

David Dunclee, Aquaterra, Inc., P.O. Box 50328, Raleigh, NC 27650
Stephen Barnhardt, DEHNR, Fayetteville Reg. Office, Fayetteville, NC
28301-5043



an IEA company

P.O. Box 100
Reservoir Rd.
(919) 677-0000

North Carolina 27709

FAX (919) 677-0420

November 18, 1991

Steve Burrows
Aquaterra, Inc.
4209-B Stuart Andrew Blvd.
Charlotte, NC 28217

Reference IEA Report No.: 794231
Project I.D.: C467

Dear Mr. Burrows,

Transmitted herewith are the results of analyses on three samples submitted to our laboratory.

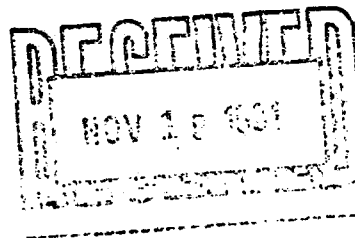
Please see the enclosed reports for your results.

Very truly yours,

IEA, Inc.

Linda F. Mitchell

Linda F. Mitchell
Director, Technical Support Services



State Certification:

Alabama - #40210

Tennessee - #00296

South Carolina - #99021

Georgia - #816

Virginia - #00179

North Carolina - #37720

New Jersey - #67719

#84

FAX

Monroe,
Connecticut
203-261-4458

Miramar,
Florida
305-989-0928

Schaumburg,
Illinois
708-705-0740

N. Billerica,
Massachusetts
617-272-5212

Whippany,
New Jersey
201-428-8181

Essex Junction,
Vermont
802-876-5138



PURGEABLE HALOCARBONS
EPA 601 COMPOUND LIST

IEA Sample Number: 794-231-1
Client Name: Aquaterra, Inc.
Client Project ID: C467
Sample Identification: MW 5i
Matrix: Water

Date Received: 11/01/91
Date Sampled: 10/31/91
Date Analyzed: 11/11/91
Analysis By: Averill
Dilution Factor: 1

Number	Compound	Quantitation Limit (ug/L)	Results Concentration (ug/L)
1	Chloromethane	1.0	BQL
2	Bromomethane	1.0	BQL
3	Vinyl Chloride	1.0	BQL
4	Dichlorodifluoromethane	1.0	BQL
5	Chloroethane	1.0	BQL
6	Methylene chloride	1.0	BQL
7	Trichlorofluoromethane	1.0	BQL
8	1,1-Dichloroethene	1.0	BQL
9	1,1-Dichloroethane	1.0	32
10	trans-1,2-Dichloroethene	1.0	21
11	Chloroform	1.0	BQL
12	1,2-Dichloroethane	1.0	2
13	1,1,1-Trichloroethane	1.0	BQL
14	Carbon tetrachloride	1.0	BQL
15	Bromodichloromethane	1.0	2
16	1,2-Dichloropropane	1.0	BQL
17	cis-1,3-Dichloropropene	1.0	BQL
18	Trichloroethene	1.0	BQL
19	trans-1,3-Dichloropropene	1.0	BQL
20	1,1,2-Trichloroethane	1.0	BQL
21	Dibromochloromethane	1.0	BQL
22	2-Chloroethylvinyl ether	1.0	BQL
23	Bromoform	1.0	BQL
24	Tetrachloroethene	1.0	BQL
25	1,1,2,2-Tetrachloroethane	1.0	BQL
26	Chlorobenzene	1.0	BQL
27	1,3-Dichlorobenzene	1.0	2
28	1,2-Dichlorobenzene	1.0	BQL
29	1,4-Dichlorobenzene	1.0	1
			BQL

Comments:

Sample specific quantitation limits may be calculated by multiplying the quantitation limit by the dilution factor.

BQL = Below Quantitation Limit



PURGEABLE HALOCARBONS
EPA 601 COMPOUND LIST

IEA Sample Number: 794-231-2
Client Name: Aquaterra, Inc.
Client Project ID: C467
Sample Identification: MW 6i
Matrix: Water
Date Received: 11/01/91
Date Sampled: 10/31/91
Date Analyzed: 11/10/91
Analysis By: Lewis
Dilution Factor: 1

Number	Compound	Quantitation	Results
		Limit (ug/L)	Concentration (ug/L)
1	Chloromethane	1.0	BQL
2	Bromomethane	1.0	BQL
3	Vinyl Chloride	1.0	BQL
4	Dichlorodifluoromethane	1.0	BQL
5	Chloroethane	1.0	BQL
6	Methylene chloride	1.0	BQL
7	Trichlorofluoromethane	1.0	BQL
8	1,1-Dichloroethene	1.0	BQL
9	1,1-Dichloroethane	1.0	18
10	trans-1,2-Dichloroethene	1.0	BQL
11	Chloroform	1.0	BQL
12	1,2-Dichloroethane	1.0	1
13	1,1,1-Trichloroethane	1.0	3
14	Carbon tetrachloride	1.0	BQL
15	Bromodichloromethane	1.0	BQL
16	1,2-Dichloropropane	1.0	BQL
17	cis-1,3-Dichloropropene	1.0	BQL
18	Trichloroethene	1.0	BQL
19	trans-1,3-Dichloropropene	1.0	BQL
20	1,1,2-Trichloroethane	1.0	BQL
21	Dibromochloromethane	1.0	BQL
22	2-Chloroethylvinyl ether	1.0	BQL
23	Bromoform	1.0	BQL
24	Tetrachloroethene	1.0	BQL
25	1,1,2,2-Tetrachloroethane	1.0	1
26	Chlorobenzene	1.0	BQL
27	1,3-Dichlorobenzene	1.0	13
28	1,2-Dichlorobenzene	1.0	BQL
29	1,4-Dichlorobenzene	1.0	6
			17

Comments:

Sample specific quantitation limits may be calculated by multiplying the quantitation limit by the dilution factor.

BQL = Below Quantitation Limit



PURGEABLE HALOCARBONS
EPA 601 COMPOUND LIST

IEA Sample Number: 794-231-3 Date Received: 11/01/91
Client Name: Aquaterra, Inc. Date Sampled: 10/31/91
Client Project ID: C467 Date Analyzed: 11/10/91
Sample Identification: MW 7 Analysis By: Lewis
Matrix: Water Dilution Factor: 1

Number	Compound	Quantitation	Results
		Limit (ug/L)	Concentration (ug/L)
1	Chloromethane	1.0	BQL
2	Bromomethane	1.0	BQL
3	Vinyl Chloride	1.0	BQL
4	Dichlorodifluoromethane	1.0	BQL
5	Chloroethane	1.0	BQL
6	Methylene chloride	1.0	3
7	Trichlorofluoromethane	1.0	BQL
8	1,1-Dichloroethene	1.0	BQL
9	1,1-Dichloroethane	1.0	4
10	trans-1,2-Dichloroethene	1.0	BQL
11	Chloroform	1.0	BQL
12	1,2-Dichloroethane	1.0	BQL
13	1,1,1-Trichloroethane	1.0	BQL
14	Carbon tetrachloride	1.0	BQL
15	Bromodichloromethane	1.0	BQL
16	1,2-Dichloropropane	1.0	BQL
17	cis-1,3-Dichloropropene	1.0	BQL
18	Trichloroethene	1.0	BQL
19	trans-1,3-Dichloropropene	1.0	BQL
20	1,1,2-Trichloroethane	1.0	BQL
21	Dibromochloromethane	1.0	BQL
22	2-Chloroethylvinyl ether	1.0	BQL
23	Bromoform	1.0	BQL
24	Tetrachloroethene	1.0	BQL
25	1,1,2,2-Tetrachloroethane	1.0	BQL
26	Chlorobenzene	1.0	43
27	1,3-Dichlorobenzene	1.0	2
28	1,2-Dichlorobenzene	1.0	1
29	1,4-Dichlorobenzene	1.0	7

Comments:

Sample specific quantitation limits may be calculated by multiplying the quantitation limit by the dilution factor.

BQL = Below Quantitation Limit



PURGEABLE HALOCARBONS
EPA 601 COMPOUND LIST

IEA Sample Number:	794-231	Date Received:	N/A
Client Name:	Aquaterra, Inc.	Date Sampled:	N/A
Client Project ID:	C467	Date Analyzed:	11/10/91
Sample Identification:	QC Blank	Analysis By:	Lewis
Matrix:	Water	Dilution Factor:	1

Number	Compound	Quantitation	Results
		Limit (ug/L)	Concentration (ug/L)
1	Chloromethane	1.0	BQL
2	Bromomethane	1.0	BQL
3	Vinyl Chloride	1.0	BQL
4	Dichlorodifluoromethane	1.0	BQL
5	Chloroethane	1.0	BQL
6	Methylene chloride	1.0	BQL
7	Trichlorofluoromethane	1.0	BQL
8	1,1-Dichloroethene	1.0	BQL
9	1,1-Dichloroethane	1.0	BQL
10	trans-1,2-Dichloroethene	1.0	BQL
11	Chloroform	1.0	BQL
12	1,2-Dichloroethane	1.0	BQL
13	1,1,1-Trichloroethane	1.0	BQL
14	Carbon tetrachloride	1.0	BQL
15	Bromodichloromethane	1.0	BQL
16	1,2-Dichloropropane	1.0	BQL
17	cis-1,3-Dichloropropene	1.0	BQL
18	Trichloroethene	1.0	BQL
19	trans-1,3-Dichloropropene	1.0	BQL
20	1,1,2-Trichloroethane	1.0	BQL
21	Dibromochloromethane	1.0	BQL
22	2-Chloroethylvinyl ether	1.0	BQL
23	Bromoform	1.0	BQL
24	Tetrachloroethene	1.0	BQL
25	1,1,2,2-Tetrachloroethane	1.0	BQL
26	Chlorobenzene	1.0	BQL
27	1,3-Dichlorobenzene	1.0	BQL
28	1,2-Dichlorobenzene	1.0	BQL
29	1,4-Dichlorobenzene	1.0	BQL

Comments:

Sample specific quantitation limits may be calculated by multiplying the quantitation limit by the dilution factor.

BQL = Below Quantitation Limit

N/A = Not Applicable

Corresponding Sample: 794-231-2 and 794-231-3



PURGEABLE HALOCARBONS
EPA 601 COMPOUND LIST

IEA Sample Number:	794-231	Date Received:	N/A
Client Name:	Aquaterra, Inc.	Date Sampled:	N/A
Client Project ID:	C467	Date Analyzed:	11/11/91
Sample Identification:	QC Blank	Analysis By:	Averill
Matrix:	Water	Dilution Factor:	1

Number	Compound	Quantitation	Results
		Limit (ug/L)	Concentration (ug/L)
1	Chloromethane	1.0	BQL
2	Bromomethane	1.0	BQL
3	Vinyl Chloride	1.0	BQL
4	Dichlorodifluoromethane	1.0	BQL
5	Chloroethane	1.0	BQL
6	Methylene chloride	1.0	BQL
7	Trichlorofluoromethane	1.0	BQL
8	1,1-Dichloroethene	1.0	BQL
9	1,1-Dichloroethane	1.0	BQL
10	trans-1,2-Dichloroethene	1.0	BQL
11	Chloroform	1.0	BQL
12	1,2-Dichloroethane	1.0	BQL
13	1,1,1-Trichloroethane	1.0	BQL
14	Carbon tetrachloride	1.0	BQL
15	Bromodichloromethane	1.0	BQL
16	1,2-Dichloropropane	1.0	BQL
17	cis-1,3-Dichloropropene	1.0	BQL
18	Trichloroethene	1.0	BQL
19	trans-1,3-Dichloropropene	1.0	BQL
20	1,1,2-Trichloroethane	1.0	BQL
21	Dibromochloromethane	1.0	BQL
22	2-Chloroethylvinyl ether	1.0	BQL
23	Bromoform	1.0	BQL
24	Tetrachloroethene	1.0	BQL
25	1,1,2,2-Tetrachloroethane	1.0	BQL
26	Chlorobenzene	1.0	BQL
27	1,3-Dichlorobenzene	1.0	BQL
28	1,2-Dichlorobenzene	1.0	BQL
29	1,4-Dichlorobenzene	1.0	BQL

Comments:

Sample specific quantitation limits may be calculated by multiplying the quantitation limit by the dilution factor.

BQL = Below Quantitation Limit

N/A = Not Applicable

Corresponding Sample: 794-231-1

CHAIN OF CUSTODY RECORD

[illegible]

WELL CONSTRUCTION RECORD

MW-8

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

DRILLING CONTRACTOR Carolina Drilling

DRILLER REGISTRATION NUMBER 728

STATE WELL CONSTRUCTION
PERMIT NUMBER: 46-0064-WM-0060

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Raeford, North Carolina
401 Bypass & State Highway 210
(Road, Community, or Subdivision and Lot No.)

County: Hoke

2. OWNER Burlington Industries, Inc.

ADDRESS Post Office Box 788
Clarksville, VA 23927
(Street or Route No.)
City or Town State Zip Code

Depth DRILLING LOG
From To Formation, Description

3. DATE DRILLED 1-14-92 USE OF WELL Monitoring

4. TOTAL DEPTH 28.5' CUTTINGS COLLECTED ☒ Yes ☐ No

5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

6. STATIC WATER LEVEL: 8.92 FT. ☐ above TOP OF CASING.
☒ below
TOP OF CASING IS 0.0 FT. ABOVE LAND SURFACE.

7. YIELD (gpm): N/A METHOD OF TEST _____

8. WATER ZONES (depth): N/A

9. CHLORINATION: Type N/A Amount _____

10. CASING:

Depth	Diameter	Wall Thickness or Weight/Ft.	Material
From <u>0.0</u> To <u>10.0</u> Ft.	<u>2"</u>	<u>Sch. 40</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

11. GROUT:

Depth	Material	Method
From <u>0.0</u> To <u>7.0</u> Ft.	<u>Portland #1</u>	<u>Pour</u>
From _____ To _____ Ft.	_____	_____

See Attached

12. SCREEN:

Depth	Diameter	Slot Size	Material
From <u>10.0</u> To <u>20.0</u> Ft.	<u>2</u> in.	<u>0.010</u> in.	<u>PVC</u>
From _____ To _____ Ft.	_____ in.	_____ in.	_____
From _____ To _____ Ft.	_____ in.	_____ in.	_____

13. GRAVEL PACK:

Depth	Size	Material
From <u>8.0</u> To <u>28.5</u> Ft.	<u>Torpedo</u>	<u>Sand</u>
From _____ To _____ Ft.	_____	_____

14. REMARKS: Bentonite seal from: 7.0' to 8.0'

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Shirley M. Brum
SIGNATURE OF CONTRACTOR OR AGENT

1-21-92
DATE

Submit original to Division of Environmental Management and copy to well owner.

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

MW-6d

DRILLING CONTRACTOR Carolina Drilling

DRILLER REGISTRATION NUMBER 728

STATE WELL CONSTRUCTION

PERMIT NUMBER: 46-0064-WM-0060

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Raeford, North Carolina
401 Bypass & State Highway 210
(Road, Community, or Subdivision and Lot No.)

County: Hoke

2. OWNER Burlington Industries, Inc.

ADDRESS Post Office Box 788
Clarksville, VA 23927
(Street or Route No.)
City or Town State Zip Code

Depth
From To
DRILLING LOG
Formation Description

3. DATE DRILLED 1-13&14-92 USE OF WELL Monitoring

4. TOTAL DEPTH 76.0' CUTTINGS COLLECTED ☒ Yes ☐ No

5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

6. STATIC WATER LEVEL: 47.4 FT. ☐ above TOP OF CASING,
TOP OF CASING IS 0.0 FT. ☒ below ABOVE LAND SURFACE.

7. YIELD (gpm): N/A METHOD OF TEST _____

8. WATER ZONES (depth): N/A

9. CHLORINATION: Type N/A Amount _____

10. CASING:

	Depth	Diameter	Wall Thickness or Weight/Ft.	Material
Outer From	<u>0.0</u>	To <u>47.5</u> Ft.	<u>6"</u>	<u>Sch.40</u>
Inner From	<u>0.0</u>	To <u>70.0</u> Ft.	<u>2"</u>	<u>Sch.40</u>
	From _____	To _____ Ft.		

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

11. GROUT:

	Depth	Material	Method
From	<u>0.0</u>	To <u>65.0</u> Ft.	<u>Portland #1 Pour</u>
From	_____	To _____ Ft.	

See Attached

12. SCREEN:

	Depth	Diameter	Slot Size	Material
From	<u>70.0</u>	To <u>75.0</u> Ft.	<u>2</u> in.	<u>0.010 in. PVC</u>
From	_____	To _____ Ft.	_____ in.	_____
From	_____	To _____ Ft.	_____ in.	_____

13. GRAVEL PACK:

	Depth	Size	Material
From	<u>67.0</u>	To <u>76.0</u> Ft.	<u>Torpedo Sand</u>
From	_____	To _____ Ft.	

14. REMARKS: Bentonite seal from: 65.0' to 67.0'

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Steve M. Brown
SIGNATURE OF CONTRACTOR OR AGENT

1-21-92
DATE

Submit original to Division of Environmental Management and copy to well owner.

Serial No. _____
Long. _____ Po. _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

MW-10

DRILLING CONTRACTOR Carolina Drilling

DRILLER REGISTRATION NUMBER 728

STATE WELL CONSTRUCTION

PERMIT NUMBER: 46-0064-WM-0060

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Raeford, North Carolina
401 Bypass & State Highway 210
(Road, Community, or Subdivision and Lot No.)

County: Hoke

2. OWNER Burlington Industries, Inc.

ADDRESS Post Office Box 788

Clarksville, VA 23927

City or Town State Zip Code

3. DATE DRILLED 1-14-92 USE OF WELL Monitoring

4. TOTAL DEPTH 25.0 CUTTINGS COLLECTED ☒ Yes ☐ No

5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

6. STATIC WATER LEVEL: 11.28 FT. ☐ above TOP OF CASING.
☒ below
TOP OF CASING IS 0.0 FT. ABOVE LAND SURFACE.

7. YIELD (gpm): N/A METHOD OF TEST _____

8. WATER ZONES (depth): N/A

9. CHLORINATION: Type N/A Amount: _____

10. CASING:

Depth	Diameter	Wall Thickness or Weight/Ft.	Material
From <u>0.0</u> To <u>10.0</u> Ft.	<u>2"</u>	<u>Sch. 40</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

11. GROUT:

Depth	Material	Method
From <u>0.0</u> To <u>7.0</u> Ft.	<u>Portland</u>	<u>Pour</u>
From _____ To _____ Ft.	_____	_____

12. SCREEN:

Depth	Diameter	Slot Size	Material
From <u>10.0</u> To <u>20.0</u> Ft.	<u>2</u>	<u>in. 0.010 in.</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

13. GRAVEL PACK:

Depth	Size	Material
From <u>8.0</u> To <u>25.0</u> Ft.	<u>Torpedo</u>	<u>Sand</u>
From _____ To _____ Ft.	_____	_____

14. REMARKS: Bentonite seal from: 7.0' to 8.0'

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT

DATE

Submit original to Division of Environmental Management and copy to well owner.

FOR OFFICE USE ONLY

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

MW-9

DRILLING CONTRACTOR Carolina Drilling

DRILLER REGISTRATION NUMBER 728

STATE WELL CONSTRUCTION
PERMIT NUMBER: 46-0064-WM-0060

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Raeford, North Carolina
401 Bypass & State Highway 210
(Road, Community, or Subdivision and Lot No.)

County: Hoke

2. OWNER Burlington Industries, Inc.

ADDRESS Post Office Box 788
Clarksville, VA 23927
(Street or Route No.)
City or Town State Zip Code

Depth DRILLING LOG
From To Formation Description

3. DATE DRILLED 1-15-92 USE OF WELL Monitoring

4. TOTAL DEPTH 25.0 CUTTINGS COLLECTED ☒ Yes ☐ No

5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

6. STATIC WATER LEVEL: 12.83 FT. ☐ above TOP OF CASING,
TOP OF CASING IS 0.0 FT. ☒ below ABOVE LAND SURFACE.

7. YIELD (gpm): N/A METHOD OF TEST _____

8. WATER ZONES (depth): N/A

9. CHLORINATION: Type N/A Amount _____

10. CASING:

Depth	Diameter	Wall Thickness or Weight/Ft.	Material
From <u>0.0</u> To <u>10.0</u> Ft.	<u>2"</u>	<u>Sch. 40</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Roads, or other map reference points)

11. GROUT:

Depth	Material	Method
From <u>0.0</u> To <u>7.0</u> Ft.	<u>Portland</u>	<u>Pour</u>
From _____ To _____ Ft.	_____	_____

See Attached

12. SCREEN:

Depth	Diameter	Slot Size	Material
From <u>10.0</u> To <u>20.0</u> Ft.	<u>2</u> in.	<u>0.010</u> in.	<u>PVC</u>
From _____ To _____ Ft.	_____ in.	_____ in.	_____
From _____ To _____ Ft.	_____ in.	_____ in.	_____

13. GRAVEL PACK:

Depth	Size	Material
From <u>8.0</u> To <u>25.0</u> Ft.	<u>Torpedo</u>	<u>Sand</u>
From _____ To _____ Ft.	_____	_____

14. REMARKS: Bentonite seal from: 7.0' to 8.0'

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT

1-21-92

DATE

Submit original to Division of Environmental Management and copy to well owner.

STANDARD SUB-GRADE 2" MONITORING WELL CONSTRUCTION

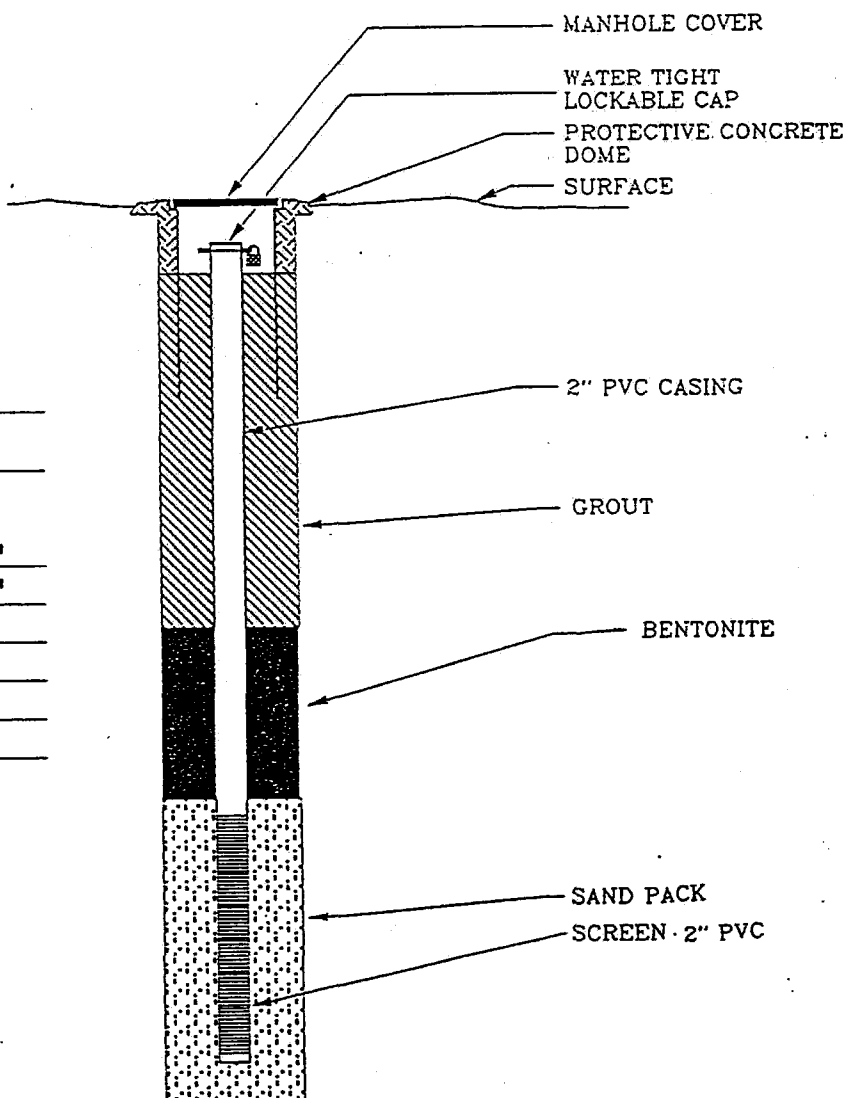
WELL NUMBER: MW-8 DRILLING METHOD: Hollow Stem Auger
 DATE STARTED: 1-14-92 DRILLING FLUIDS: None
 DATE FINISHED: 1-14-92 STATIC WATER LEVEL: _____ DATE: _____
 GEOLOGIST/ENG: Scott Ball OBSERVED BY: George Bridger
 REMARKS: Total Depth (TD) Well Boring = 28.5'; TD Wellpoint = 20.2'
Wellpoint Length = 0.20'

O.D. OF BOREHOLE: 8"
 O.D. OF CASING: 2.375"

PIPE STICKUP: 0.0'
 SURFACE ELEVATION: --
 GROUT TYPE: Portland #1
 CASING TYPE: PVC Sch. 40
 CASING SIZE: 2"
 DEPTH TO BOTTOM
 OF CASING 10.0'

DEPTH TO TOP OF BENTONITE 7.0'
 DEPTH TO TOP OF GRAVEL 8.0'

DEPTH TO TOP OF SCREEN 10.0'
 DEPTH TO BOTTOM OF SCREEN 20.0'
 LENGTH OF SCREEN: 10.0'
 SCREEN OPENING SIZE: 0.010"
 SCREEN TYPE: PVC Sch. 40
 SCREEN SIZE: 2"; Slotted



PROJECT:
 Burlington Industries, Inc
 Raeford, North Carolina

TITLE: MW-8 Well Schematic
 JOB: C467 DRAWING: -- FIGURE: -- SCALE: 1" = 1'



AQUATERRA, INC.
 RALEIGH, GREENSBORO, CHARLOTTE
 NORTH CAROLINA

STANDARD SUB-GRADE 2" MONITORING WELL CONSTRUCTION SCHEMATIC

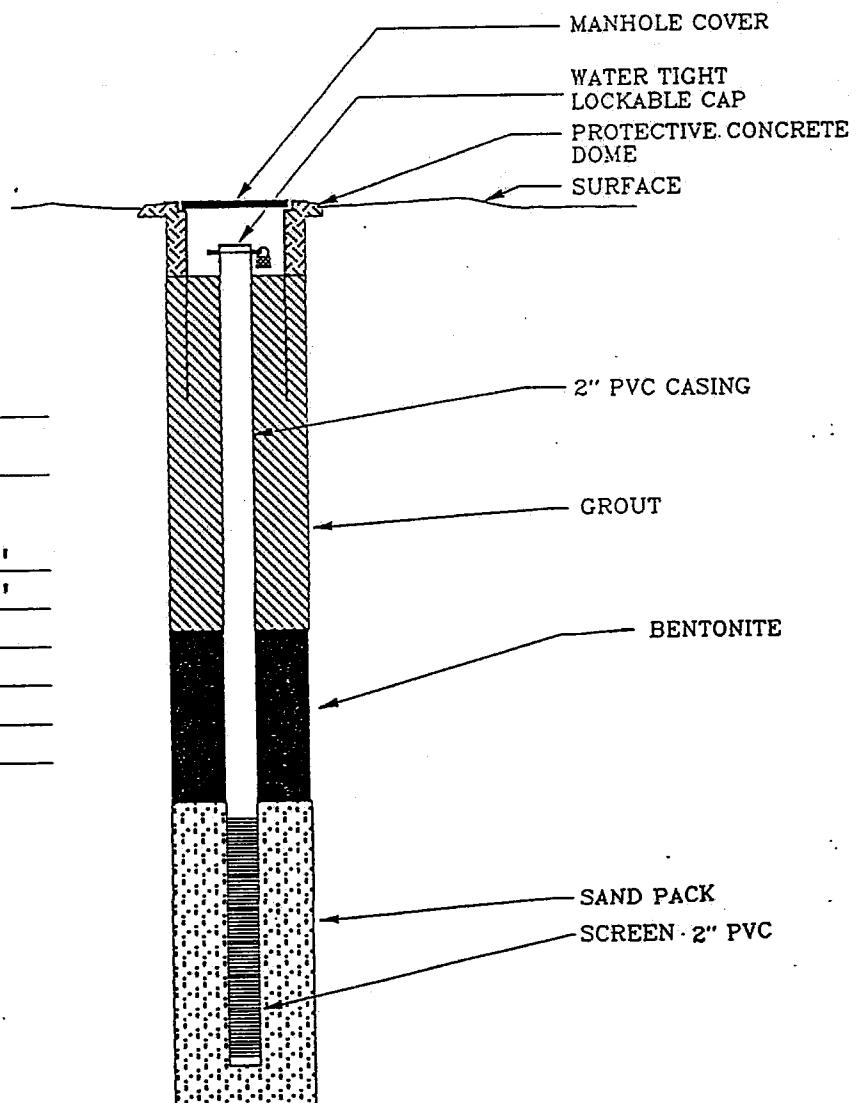
WELL NUMBER: MW-9 DRILLING METHOD: Hollow Stem Auger
 DATE STARTED: 1-15-92 DRILLING FLUIDS: None
 DATE FINISHED: 1-15-92 STATIC WATER LEVEL: _____ DATE: _____
 GEOLOGIST/ENG Scott Ball OBSERVED BY: George Bridger
 REMARKS: Total Depth (TD) Well Boring = 25.0'; TD Wellpoint = 20.2'
Wellpoint Length = 0.2'

O.D. OF BOREHOLE: 8"
 O.D. OF CASING: 2.375"

PIPE STICKUP: 0.0'
 SURFACE ELEVATION: --
 GROUT TYPE: Portland #1
 CASING TYPE: PVC Sch. 40
 CASING SIZE: 2"
 DEPTH TO BOTTOM
 OF CASING 10.0'

DEPTH TO TOP OF BENTONITE 7.0'
 DEPTH TO TOP OF GRAVEL 8.0'

DEPTH TO TOP OF SCREEN 10.0'
 DEPTH TO BOTTOM OF SCREEN 20.0'
 LENGTH OF SCREEN: 10.0'
 SCREEN OPENING SIZE: 0.010"
 SCREEN TYPE: PVC Sch. 40
 SCREEN SIZE: 2"; Slotted



PROJECT:
 Burlington Industries, Inc
 Raeford, North Carolina

TITLE: MW-9 Well Schematic
 JOB: C467 DRAWING: -- FIGURE: -- SCALE: 1' = 1'



AQUATERRA, INC.
 RALEIGH, GREENSBORO, CHARLOTTE
 NORTH CAROLINA

STANDARD SUB-GRADE 2" MONITORING WELL CONSTRUCTION SCHEMATIC

WELL NUMBER: MW-10 DRILLING METHOD: Hollow Stem Auger
 DATE STARTED: 1-14-92 DRILLING FLUIDS: None
 DATE FINISHED: 1-14-92 STATIC WATER LEVEL: _____ DATE: _____
 GEOLOGIST/ENG: Scott Ball OBSERVED BY: George Bridger
 REMARKS: Total Depth (TD) Well Boring = 25.0'; TD Wellpoint = 20.20'
Wellpoint Length = 0.20'

O.D. OF BOREHOLE: 8"
 O.D. OF CASING: 2.375"

PIPE STICKUP: 0.0'
 SURFACE ELEVATION: --

GROUT TYPE: Portland #1

CASING TYPE: PVC Sch. 40

CASING SIZE: 2"

DEPTH TO BOTTOM
 OF CASING 10.0'

DEPTH TO TOP OF BENTONITE 7.0'

DEPTH TO TOP OF GRAVEL 8.0'

DEPTH TO TOP OF SCREEN 10.0'

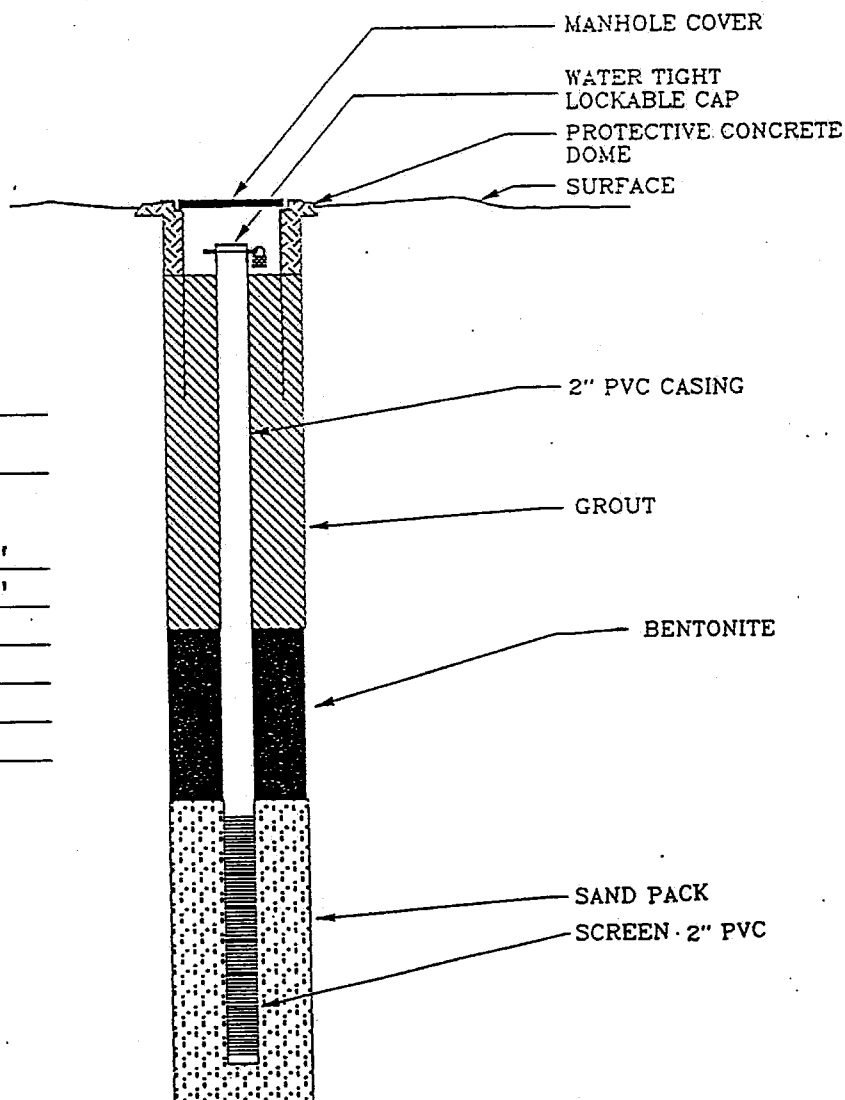
DEPTH TO BOTTOM OF SCREEN 20.0'

LENGTH OF SCREEN: 10.0'

SCREEN OPENING SIZE: 0.010"

SCREEN TYPE: PVC Sch. 40

SCREEN SIZE: 2"; Slotted



PROJECT:
 Burlington Industries, Inc
 Raeford, North Carolina

TITLE:
 MW-10 Well Schematic
 JOB: C467
 DRAWING: --
 FIGURE: --
 SCALE: 1' - 1'



AQUATERRA, INC.
 RALEIGH, GREENSBORO, CHARLOTTE
 NORTH CAROLINA

WELL NUMBER: MW-6d DRILLING METHOD: Hollow Stem Auger
 DATE STARTED: 1-13-92 DRILLING FLUIDS: None
 DATE FINISHED: 1-14-92 STATIC WATER LEVEL: _____ DATE: _____
 GEOLOGIST/ENG Scott Ball OBSERVED BY: George Bridger
 REMARKS: Total Depth (TD) Well Boring = 76.0'; TD Wellpoint = 75.20';
Wellpoint Length = 0.20'

O.D. OF BOREHOLE: 9"
 O.D. OF CASING: 2.375"

PIPE STICKUP: 0.0'
 SURFACE ELEVATION: --
 GROUT TYPE: Portland #1

* (INNER)

CASING TYPE: PVC Sch. 40
 CASING SIZE: 2"
 BOREHOLE DIAMETER: 6"

* (OUTER)

CASING TYPE: PVC Sch 40
 CASING SIZE: 6"
 BOREHOLE DIAMETER: 9"

DEPTH TO BOTTOM
 OF OUTER CASING 47.5'
 DEPTH TO BOTTOM
 OF INNER CASING 70.0'

DEPTH TO TOP OF BENTONITE 65.0'

DEPTH TO TOP OF GRAVEL 67.0'

DEPTH TO TOP OF SCREEN 70.0'

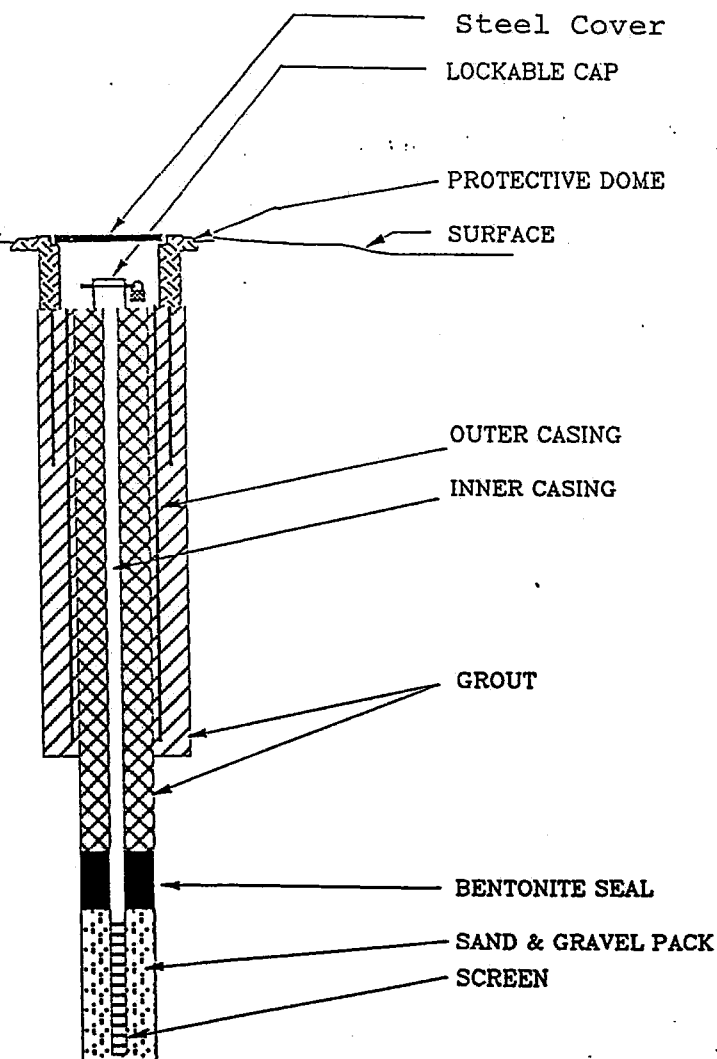
DEPTH TO BOTTOM OF SCREEN 75.0'

LENGTH OF SCREEN: 5.0'

SCREEN OPENING SIZE: 0.010"

SCREEN TYPE: PVC Sch. 40

SCREEN SIZE: 2"; slotted



PROJECT:

Burlington Industries
 Raeford, North Carolina

TITLE:

MW-6d Well Schematic

JOB:

C467

DRAWING:

-

FIGURE:

-

SCALE:

-



AQUATERRA, INC.

RALEIGH, GREENSBORO, CHARLOTTE
 NORTH CAROLINA



AQUA

Subsurface Drill Log

Depth (Feet)	SOIL/MATERIAL DESCRIPTION	Surface Elevation	SAMPLES	OVA Results (ppm)		Remarks
				SPT. SPOON	CUTTINGS	
	Grass, grass roots, and topsoil					
	Dark brown sandy CLAY (ML)		BDL			Spoon: 3.5'-5.0' Blows: 2-3-4 No solvent odor
5						
	Tan silty CLAY (ML)		BDL			Spoon: 8.5'-10.0' Blows: 3-5-9 No solvent odor
10						
	Yellow sandy CLAY (ML)		BDL			Spoon: 13.5'-15.0' Blows: 2-3-3 No solvent odor
15						
	Orange sand CLAY (ML)					
20						
	Yellow sandy CLAY (ML)					
25						
	Boring terminated @ 28.5' below grade in yellow sandy CLAY (ML)					BDL-Below OVA detection limit of 0.01 ppm total volatilized organic compounds

Drilling & Sampling Meets ASTM D-1586 & ASTM D-1587

Page 1 of 1Supervisor Scott BallLocation BI - Raeford, North CarolinaRig Type Hollow Stem AugerDate Drilled 1-14-92Weather Sunny, 35°FJob Number C467



AGI, INC.

MW-5

Subsurface Drill Log

Depth (Feet)	SOIL/MATERIAL DESCRIPTION	Surface Elevation	SAMPLES	OVA Results (ppm)		Remarks
				SPT. SPOON	CUTTINGS	
	Grass, grass roots and topsoil					
	Brick red sandy, silty CLAY (ML)		BDL			Spoon: 3.5'-5.0' Blows: 3-4-6 No solvent odor
5	Light brown to dark brown silty CLAY (ML)		BDL			Spoon: 8.5'-10.0' Blows: 4-8-5 No solvent odor
10						
	Light tan, light gray, and pink sandy CLAY (ML)		0.5			Spoon: 13.5'-15.0' Blows: 3-6-7 No solvent odor
15						
20						
	Yellow sandy CLAY (ML)					
25	Boring terminated @ 25.0' below grade in yellow sandy CLAY (ML)					
	BDL-Below OVA detection limit of 0.01 ppm total volatilized organic compounds					

Drilling & Sampling Meets ASTM D-1586 & ASTM D-1587

Supervisor Scott BallRig Type Hollow Stem AugerWeather Sunny; 35°FPage 1 of 1Location BI - Raeford, North CarolinaDate Drilled 1-15-92Job Number C467



AQUATERRA, INC.

MW-10

Subsurface Drill Log

Depth (Feet)	SOIL/MATERIAL DESCRIPTION	Surface Elevation	SAMPLES	OVA Results (ppm)		Remarks
				SPT. SPOON	CUTTINGS	
	Asphalt and composite stone					
5	Tan to dark brown sandy CLAY (ML)		BDL			Spoon: 3.5'-5.0' Blows: 1-3-3 No solvent odor
10	Tan and pink sandy CLAY (ML)		BDL			Spoon: 8.5'-10.0' Blows: 4-6-7 No solvent odor
15			BDL			Spoon: 13.5'-15.0' Blows: 4-4-6 No solvent odor
20	Light to medium gray sandy CLAY (ML)					
25	Boring terminated @ 25.0' below grade in light to medium gray sandy CLAY (ML)					
BDL-Below OVA detection limit of 0.01 ppm total volatilized organic compounds						

Drilling & Sampling Meets ASTM D-1586 & ASTM D-1587

Page 1 of 1Supervisor Scott BallLocation BI - Raeford, North CarolinaRig Type Hollow Stem AugerDate Drilled 1-14-92Weather Sunny; 35°FJob Number C467



Depth (Feet)	SOIL/MATERIAL DESCRIPTION	Surface Elevation	SAMPLES	OVA Results (ppm)		Remarks
				SPT. SPOON	CUTTINGS	
	Topsoil and grass roots					
	Orange-tan silty CLAY (ML)			BDL		Spoon: 3.5'-5.0' Blows: 8-12-15 No solvent odor
	Pink-tan silty CLAY (ML)					
20				BDL		Spoon: 8.5'-10.0' Blows: 3-5-6 No solvent odor
	Tan sandy CLAY (CL)					Wet soil cuttings @ 12.0' b.g.
40						
	Brick red CLAY (CL)					
60	Dark tan sandy CLAY (CL)					
	Yellow sandy CLAY (CL)					
80	Boring terminated @ 76.0' below grade in yellow sandy CLAY (CL)					
100						
BDL-Below OVA detection limit of 0.01 ppm total volatilized organic compounds						

Drilling & Sampling Meets ASTM D-1586 & ASTM D-1587

Page 1 of 1

Supervisor Scott BallLocation BI-Raeferd, North CarolinaRig Type Hollow Stem AugerDate Drilled 1-13 thru 1-14-92Weather Sunny; 40°FJob Number C467

DRAWDOWN TEST

Job Name B.I. - Raeford Location NC Job # C467
 Well Number MW-8 Date 1-16-92 Test Conducted By Scott Ball

WELL INFORMATION

Top of Casing Elevation 87.52 Ground Surface Elevation N/A
 Casing Diameter 2" Borehole Diameter 8" Screen Depth 10.0'-20.0'
 Evacuation Method Bailer Amt. Water Removed 8 gallons Reference Point Toe

RECOVERY DATA

orig. SWL 8.85

Elapsed Time	Groundwater Depth	H	H/H ₀
T.0	8.85	-	-
0.0	10.83	1.98	100
.5	10.15	1.30	0.66
1.0	9.92	1.07	0.54
1.5	9.68	.83	0.42
2.0	9.55	.70	0.35
2.5	9.45	.60	0.30
3.0	9.38	.53	0.27
3.5	9.30	.45	0.23
4.0	9.27	.42	0.21
4.5	9.21	.36	0.18
5.0	9.20	.35	0.18
6	9.10	.25	0.13
7	9.07	.22	0.11
8	9.04	.19	0.10
9	9.04	.19	0.10
10	9.01	.16	0.08
11	9.01	.16	0.08
12	8.99	.14	0.07
14	8.98	.13	0.07
16	8.98	.13	0.07
18	8.95	.10	0.05
20	8.92	.07	0.04
22	8.89	.04	0.02

B1-Race St MW-8

46-5010

WATER & POWER DIVISIONS

WATER

Well Number: MW-8Date: 3-24-92Computed By: D. Duncanson

Casing diameter $d = \underline{6.03}$ (cm)
 Borehole diameter $D = \underline{20.32}$ (cm)
 Length of screen $L = \underline{333.76}$ (cm)
 Time lag at $0.37 H/H_o$ $T = \underline{120}$ (seconds)

$$k_h = \frac{d^2 \ln \left[\frac{2mL}{D} \right]}{8 LT} \quad m = 1$$

Note: This equation is valid only for a typical monitoring well situation. If the situation differs significantly consult Foundation Engineering Handbook, Winterkorn & Fang, pp. 29-35.

$$k_h = \frac{6.03^2 \ln \left[\frac{2(1)(333.76)}{20.32} \right]}{8(1)(120)} = \frac{126.4}{3.2 \times 10^5}$$

Note: $m = \sqrt{k_{\text{horizontal}}/k_{\text{vertical}}}$ Assume $k_h = k_v = 1$

$$k_h = \underline{3.95 \times 10^{-4}}$$

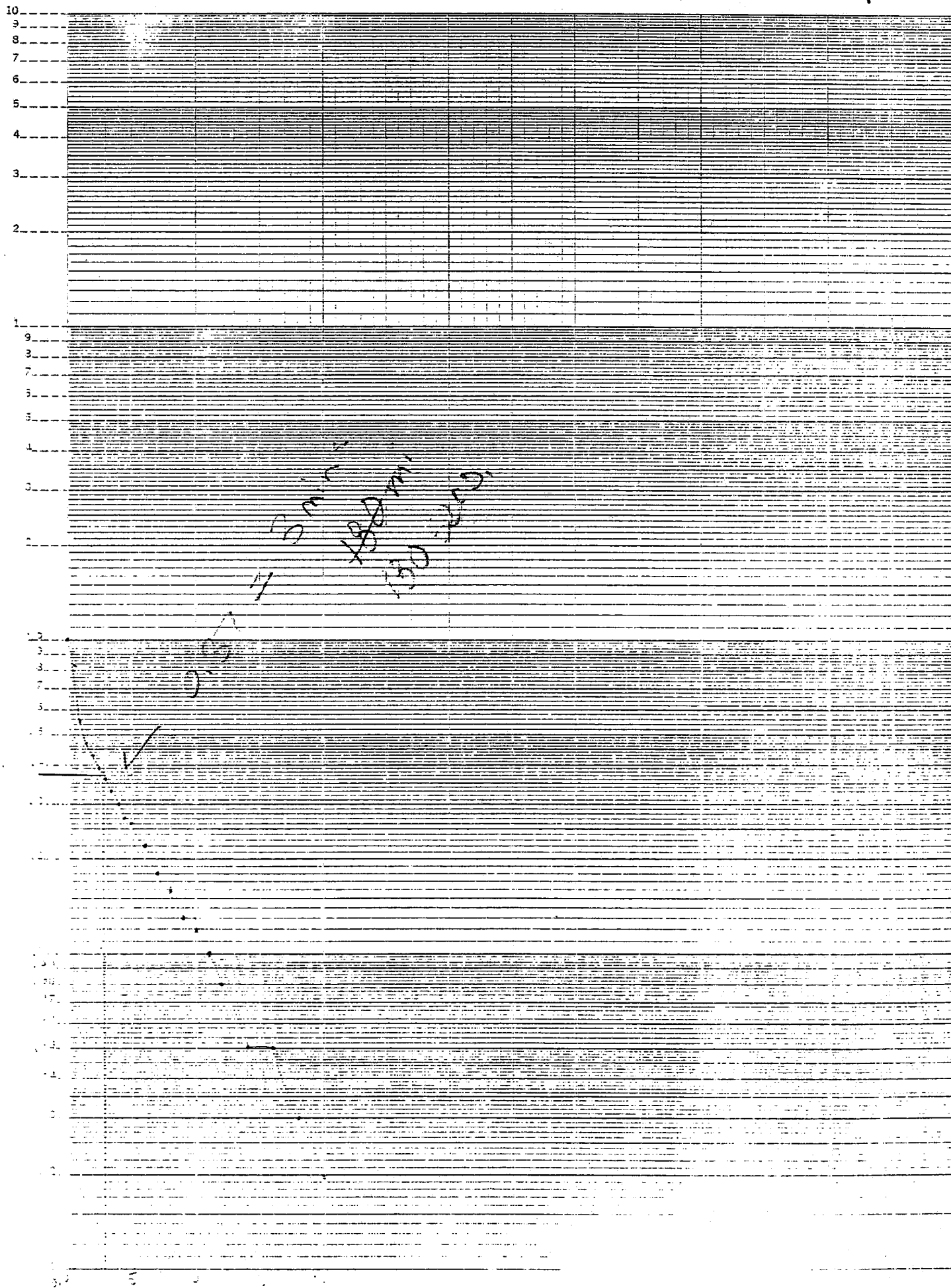
DRAWDOWN TESTJob Name B.I. Location Raeferd Job # C467Well Number mw-9 Date 1/16/92 Test Conducted By Scott BallWELL INFORMATIONTop of Casing Elevation 96.32 Ground Surface Elevation N/ACasing Diameter 2" Borehole Diameter 8" Screen Depth 10.0'-20.0'Evacuation Method Bailer Amt. Water Removed 7 gallons Reference Point TOCRECOVERY DATA

Elapsed Time	Groundwater Depth	H	H/H ₀
T.O.	12.81	—	—
0.0	16.61	3.80	100
.5	15.95	3.14	.83
1	14.90	2.09	.55
1.5	14.59	1.78	.47
2	14.45	1.64	.43
2.5	14.29	1.48	.39
3	14.16	1.35	.36
3.5	14.05	1.24	.33
4	13.95	1.14	.30
4.5	13.85	1.04	.27
5	13.79	0.98	.26
6	13.64	0.83	.22
7	13.51	0.70	.18
8	13.40	0.59	.16
9	13.30	0.49	.13
10	13.25	0.44	.12
11	13.18	0.37	.10
12	13.11	0.30	.08
14	13.01	0.20	.05
16	13.00	0.19	.05
18	12.91	0.10	.03
20	12.88	0.07	.02

B.I. Raeford MW-9

46 6010

FIELD INVESTIGATION DIVISION
U.S. GEOLOGICAL SURVEY



Well Number: MW-9

Date: 3-25-92

Computed By: Drew Dunclee

Casing diameter $d = \underline{6.03}$ (cm)
 Borehole diameter $D = \underline{20.32}$ (cm)
 Length of screen $L = \underline{213.97}$ (cm)
 Time lag at 0.37 H/H_o $T = \underline{180}$ (seconds)

$$k_h = \frac{d^2 \ln \left[\frac{2mL}{D} \right]}{8 LT} \quad m = 1$$

Note: This equation is valid only for a typical monitoring well situation. If the situation differs significantly consult Foundation Engineering Handbook, Winterkorn & Fang, pp. 29-35.

$$k_h = \frac{(6.03)^2 \ln \left[\frac{2(1)(213.97)}{20.32} \right]}{8(213.97)(180)} = \frac{110.31}{3.05 \times 10^5}$$

Note:

$$m = \sqrt{k_{\text{horizontal}} / k_{\text{vertical}}}$$

Assume $k_h = k_v = 1$

$$k_h = \underline{3.59 \times 10^{-4}}$$

DRAWDOWN TEST

Job Name B.I. Location Raeford Job # C467
Well Number mw-10 Date 1/16/92 Test Conducted By Scott Ball

WELL INFORMATION

Top of Casing Elevation 98.22 Ground Surface Elevation N/A
Casing Diameter 2" Borehole Diameter 8" Screen Depth 10.0'-20.0'
Evacuation Method Bailer Amt. Water Removed 7 gallons Reference Point T.O.C.

RECOVERY DATA

[illegible]

mw-10

70 DIVISIONS

Well Number: mw-10

Date: 3-25-92

Computed By: Drew Doncklee

Casing diameter $d = \underline{6.03}$ (cm)
 Borehole diameter $D = \underline{20.32}$ (cm)
 Length of screen $L = \underline{262.13}$ (cm)
 Time lag at $0.37 H/H_0$ $T = \underline{60}$ (seconds)

$$k_h = \frac{d^2 \ln \left[\frac{2mL}{D} \right]}{8 LT} \quad m = 1$$

Note: This equation is valid only for a typical monitoring well situation. If the situation differs significantly consult Foundation Engineering Handbook, Winterkorn & Fang, pp. 29-35.

$$k_h = \frac{6.03^2 \ln \left[\frac{2(1)(262.13)}{20.32} \right]}{8(262.13)(60)} = \frac{118.19}{1.25 \times 10^5}$$

Note: $m = \sqrt{k_{\text{horizontal}}/k_{\text{vertical}}}$ Assume $k_h = k_v = 1$

$$k_h = \underline{9.59 \times 10^{-5} \text{ cm}^2/\text{sec}}$$



January 27, 1992

Mr. Steve Burrows
Aquaterra, Inc.
4209-B Stuart Andrew Blvd.
Charlotte, NC 28217

Dear Mr. Burrows:

Enclosed are results from four (4) samples we received from you on 01/17/92 (Project #C1454) as follows:

MW6a
MW9
MW10
MW8

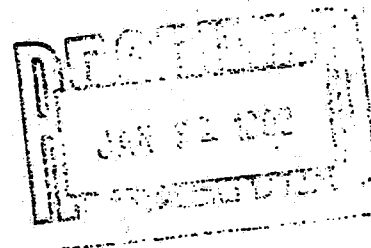
Also enclosed is the Chain of Custody and Invoice. If you have any questions, please contact me at (502) 223-0251.

Sincerely,

A handwritten signature in cursive script that reads "Steven Furnish".

Steven Furnish
Director

Enclosure





January 24, 1992

Mr. Steve Burrows
Aquaterra, Inc.
4209-B Stuart Andrew Blvd.
Charlotte, NC 28217

LABORATORY RESULTS

CONTROL #:	6659	SAMPLE ID:	MW6d
RECEIVED :	01/17/92	MATRIX :	WATER
ANALYZED :	01/23/92	METHOD :	601
SAMPLED :	01/16/92	PROJECT :	#C467

METHOD 601

PARAMETER	AMOUNT	UNITS
BROMODICHLOROMETHANE	ND<0.10	ug/L
BROMOFORM	ND<0.20	"
BROMOMETHANE	ND<1.18	"
CARBON TETRACHLORIDE	9.9	"
CHLOROBENZENE	ND<0.25	"
CHLOROETHANE	ND<0.52	"
2-CHLORO ETHYL VINYL ETHER	ND<0.13	"
CHLOROFORM	1.42	"
CHLOROMETHANE	ND<0.08	"
DIBROMOCHLOROMETHANE	ND<0.09	"
1,2-DICHLOROBENZENE	ND<0.15	"
1,3-DICHLOROBENZENE	ND<0.32	"

#6659

PARAMETER	AMOUNT	UNITS
1,4-DICHLOROBENZENE	ND<0.24	ug/L
DICHLORODIFLUOROMETHANE	ND<1.81	"
1,1-DICHLOROETHENE	4.7	"
1,2-DICHLOROETHANE	ND<0.03	"
1,1-DICHLOROETHANE	4.5	"
trans-1,2-DICHLOROETHENE	ND<0.10	"
1,2-DICHLOROPROPANE	ND<0.04	"
cis-1,3-DICHLOROPROPENE	ND<0.34	"
trans-1,3-DICHLOROPROPENE	ND<0.20	"
METHYLENE CHLORIDE	ND<0.25	"
1,1,2,2-TETRACHLOROETHANE	ND<0.02	"
TETRACHLOROETHYLENE	ND<0.03	"
1,1,1-TRICHLOROETHANE	1.4	"
1,1,2-TRICHLOROETHANE	ND<0.02	"
TRICHLOROETHENE	ND<0.03	"
TRICHLOROFLUOROMETHANE	ND<0.03	"
VINYL CHLORIDE	ND<0.18	"

REVIEWED BY

Steve Farnish



January 24, 1992

Mr. Steve Burrows
Aquaterra, Inc.
4209-B Stuart Andrew Blvd.
Charlotte, NC 28217

LABORATORY RESULTS

CONTROL #:	6662	SAMPLE ID:	MW8
RECEIVED :	01/17/92	MATRIX :	WATER
ANALYZED :	01/23/92	METHOD :	601
SAMPLED :	01/16/92	PROJECT :	#C467

METHOD 601

PARAMETER	AMOUNT	UNITS
BROMODICHLOROMETHANE	ND<0.10	ug/L
BROMOFORM	ND<0.20	"
BROMOMETHANE	ND<1.18	"
CARBON TETRACHLORIDE	ND<0.12	"
CHLOROBENZENE	ND<0.25	"
CHLOROETHANE	ND<0.52	"
2-CHLORO ETHYL VINYL ETHER	ND<0.13	"
CHLOROFORM	ND<0.05	"
CHLOROMETHANE	ND<0.08	"
DIBROMOCHLOROMETHANE	ND<0.09	"
1,2-DICHLOROBENZENE	ND<0.15	"
1,3-DICHLOROBENZENE	ND<0.32	"

#5662

PARAMETER	AMOUNT	UNITS
1,4-DICHLOROBENZENE	ND<0.24	ug/L
DICHLORODIFLUOROMETHANE	ND<1.81	"
1,1-DICHLOROETHENE	ND<0.13	"
1,2-DICHLOROETHANE	ND<0.03	"
1,1-DICHLOROETHANE	ND<0.07	"
trans-1,2-DICHLOROETHENE	ND<0.10	"
1,2-DICHLOROPROPANE	ND<0.04	"
cis-1,3-DICHLOROPROPENE	ND<0.34	"
trans-1,3-DICHLOROPROPENE	ND<0.20	"
METHYLENE CHLORIDE	ND<0.25	"
1,1,2,2-TETRACHLOROETHANE	ND<0.03	"
TETRACHLOROETHYLENE	ND<0.03	"
1,1,1-TRICHLOROETHANE	ND<0.03	"
1,1,2-TRICHLOROETHANE	ND<0.02	"
TRICHLOROETHENE	ND<0.03	"
TRICHLOROFLUOROMETHANE	ND<0.03	"
VINYL CHLORIDE	ND<0.18	"

REVIEWED BY

Steve Farnish



January 24, 1992

Mr. Steve Burrows
Aquaterra, Inc.
4209-B Stuart Andrew Blvd.
Charlotte, NC 28217

LABORATORY RESULTS

CONTROL #:	6660	SAMPLE ID:	MW9
RECEIVED :	01/17/92	MATRIX :	WATER
ANALYZED :	01/23/92	METHOD :	601
SAMPLED :	01/16/92	PROJECT :	#C467

METHOD 601

PARAMETER	AMOUNT	UNITS
BROMODICHLOROMETHANE	ND<0.10	ug/L
BROMOFORM	ND<0.20	"
BROMOMETHANE	ND<1.18	"
CARBON TETRACHLORIDE	ND<0.12	"
CHLOROBENZENE	22.1	"
CHLOROETHANE	ND<0.52	"
2-CHLORO ETHYL VINYL ETHER	ND<0.13	"
CHLOROFORM	ND<0.05	"
CHLOROMETHANE	ND<0.08	"
DIBROMOCHLOROMETHANE	ND<0.09	"
1,2-DICHLOROBENZENE	ND<0.15	"
1,3-DICHLOROBENZENE	0.74	"

#6660

PARAMETER	AMOUNT	UNITS
1,4-DICHLOROBENZENE	6.15	ug/L
DICHLORODIFLUOROMETHANE	ND<1.81	"
1,1-DICHLOROETHENE	0.6	"
1,2-DICHLOROETHANE	ND<0.03	"
1,1-DICHLOROETHANE	2.64	"
trans-1,2-DICHLOROETHENE	ND<0.10	"
1,2-DICHLOROPROPANE	ND<0.04	"
cis-1,3-DICHLOROPROPENE	ND<0.34	"
trans-1,3-DICHLOROPROPENE	ND<0.20	"
METHYLENE CHLORIDE	ND<0.25	"
1,1,2,2-TETRACHLOROETHANE	ND<0.03	"
TETRACHLOROETHYLENE	2.36	"
1,1,1-TRICHLOROETHANE	ND<0.03	"
1,1,2-TRICHLOROETHANE	ND<0.02	"
TRICHLOROETHENE	1.1	"
TRICHLOROFLUOROMETHANE	ND<0.03	"
VINYL CHLORIDE	ND<0.18	"

REVIEWED BY

Steve Farnish



January 24, 1992

Mr. Steve Burrows
Aquaterra, Inc.
4209-B Stuart Andrew Blvd.
Charlotte, NC 28217

LABORATORY RESULTS

CONTROL #: 6661	SAMPLE ID: MW10
RECEIVED : 01/17/92	MATRIX : WATER
ANALYZED : 01/23/92	METHOD : 601
SAMPLED : 01/16/92	PROJECT : #C467

METHOD 601

PARAMETER	AMOUNT	UNITS
BROMODICHLOROMETHANE	ND<0.10	ug/L
BROMOFORM	ND<0.20	"
BROMOMETHANE	ND<1.18	"
CARBON TETRACHLORIDE	ND<0.12	"
CHLOROBENZENE	ND<0.25	"
CHLOROETHANE	ND<0.52	"
2-CHLORO ETHYL VINYL ETHER	ND<0.13	"
CHLOROFORM	ND<0.05	"
CHLOROMETHANE	ND<0.08	"
DIBROMOCHLOROMETHANE	ND<0.09	"
1,2-DICHLOROBENZENE	ND<0.15	"
1,3-DICHLOROBENZENE	ND<0.32	"

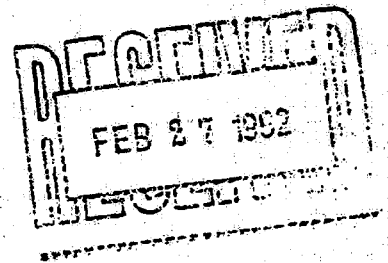
#6661

PARAMETER	AMOUNT	UNITS
1,4-DICHLOROBENZENE	ND<0.24	ug/L
DICHLORODIFLUOROMETHANE	ND<1.81	"
1,1-DICHLOROETHENE	ND<0.13	"
1,2-DICHLOROETHANE	ND<0.03	"
1,1-DICHLOROETHANE	ND<0.07	"
trans-1,2-DICHLOROETHENE	ND<0.10	"
1,2-DICHLOROPROPANE	ND<0.04	"
cis-1,3-DICHLOROPROPENE	ND<0.34	"
trans-1,3-DICHLOROPROPENE	ND<0.20	"
METHYLENE CHLORIDE	ND<0.25	"
1,1,2,2-TETRACHLOROETHANE	ND<0.03	"
TETRACHLOROETHYLENE	ND<0.03	"
1,1,1-TRICHLOROETHANE	ND<0.03	"
1,1,2-TRICHLOROETHANE	ND<0.02	"
TRICHLOROETHENE	ND<0.03	"
TRICHLOROFLUOROMETHANE	ND<0.03	"
VINYL CHLORIDE	ND<0.18	"

REVIEWED BY

Steve Farnish

[illegible]



February 24, 1992

Mr. Steve Burrows
AQUATERRA, INC.
4309-B Stuart Andrew Blvd.
Charlotte, NC 28217

Dear Mr. Burrows:

Enclosed are results from TWO (2) samples we received from you on 02/14/92 (Project #C467). Also enclosed is the Chain of Custody and Invoice. If you have any questions, please contact me at (502) 223-0251.

Sincerely,

A handwritten signature in cursive script that reads "Steven Furnish".

Steven Furnish
Director

Enclosure



February 21, 1993

Mr. Steve Burrows
AQUATERRA, INC.
4208-B Stuart Andrew Blvd.
Charlotte, NC 27217

LABORATORY RESULTS

CONTROL #:	6859	SAMPLE ID:	MW9
RECEIVED :	02/14/92	MATRIX :	WATER
ANALYZED :	02/20/92	METHOD :	601
SAMPLED :	02/13/92	PROJECT :	#C467

METHOD 601

PARAMETER	AMOUNT	UNITS
BROMODICHLOROMETHANE	ND<0.10	ug/L
BROMOFORM	ND<0.20	"
BROMOMETHANE	ND<1.18	"
CARBON TETRACHLORIDE	ND<0.12	"
CHLOROBENZENE	51	"
CHLOROETHANE	ND<0.52	"
2-CHLORO ETHYL VINYL ETHER	ND<0.13	"
CHLOROFORM	ND<0.05	"
CHLOROMETHANE	ND<0.08	"
DIBROMOCHLOROMETHANE	ND<0.09	"
1,2-DICHLOROBENZENE	1	"
1,3-DICHLOROBENZENE	2	"

28359

PARAMETER	AMOUNT	UNITS
1,4-DICHLOROBENZENE	15	ug/L
DICHLORODIFLUOROMETHANE	ND<1.51	"
1,1-DICHLOROETHENE	1	"
1,2-DICHLOROETHANE	ND<0.03	"
1,1-DICHLOROETHANE	4	"
trans-1,2-DICHLOROETHENE	ND<0.10	"
cis-1,2-DICHLOROETHENE	2	"
1,2-DICHLOROPROPANE	ND<0.04	"
cis-1,3-DICHLOROPROPENE	ND<0.54	"
trans-1,3-DICHLOROPROPENE	ND<0.20	"
METHYLENE CHLORIDE	ND<0.25	"
1,1,2,2-TETRACHLOROETHANE	ND<0.03	"
TETRACHLOROETHYLENE	3	"
1,1,1-TRICHLOROETHANE	ND<0.03	"
1,1,2-TRICHLOROETHANE	ND<0.02	"
TRICHLOROETHENE	2	"
TRICHLOROFLUOROMETHANE	ND<0.03	"
VINYL CHLORIDE	ND<0.18	"

REVIEWED BY

Steve Furnish



February 21, 1992

Mr. Steve Burrows
AQUATERRA, INC.
4108-B Stuart Andrew Blvd.
Charlotte, NC 27217

LABORATORY RESULTS

CONTROL #:	6880	SAMPLE ID:	MW-66
RECEIVED :	01/14/92	MATRIX :	WATER
ANALYZED :	08/20/92	METHOD :	601
SAMPLED :	02/13/92	PROJECT :	#C467

METHOD 601

PARAMETER	AMOUNT	UNITS
BROMODICHLOROMETHANE	ND<0.10	ug/L
BROMOFORM	ND<0.20	"
BROMOMETHANE	ND<1.18	"
CARBON TETRACHLORIDE	13	"
CHLOROBENZENE	ND<0.25	"
CHLOROETHANE	ND<0.52	"
2-CHLORO ETHYL VINYL ETHER	ND<0.13	"
CHLOROFORM	ND<0.05	"
CHLOROMETHANE	ND<0.08	"
DIBROMOCHLOROMETHANE	ND<0.09	"
1,2-DICHLOROBENZENE	ND<0.15	"
1,3-DICHLOROBENZENE	ND<0.32	"

#888

PARAMETER	AMOUNT	UNITS
1,4-DICHLOROBENZENE	2	ug/L
DICHLORODIFLUOROMETHANE	ND 1.81	"
1,1-DICHLOROETHENE	7	"
1,2-DICHLOROETHANE	ND 0.02	"
1,1-DICHLOROETHANE	7	"
trans-1,2-DICHLOROETHENE	ND 0.10	"
cis-1,2-DICHLOROETHENE	ND 0.10	"
1,2-DICHLOROPROPANE	ND 0.04	"
cis-1,3-DICHLOROPROPENE	ND 0.34	"
trans-1,3-DICHLOROPROPENE	ND 0.20	"
METHYLENE CHLORIDE	ND 0.35	"
1,1,2,2-TETRACHLOROETHANE	ND 0.03	"
TETRACHLOROETHYLENE	1	"
1,1,1-TRICHLOROETHANE	2	"
1,1,2-TRICHLOROETHANE	ND 0.02	"
TRICHLOROETHENE	ND 0.02	"
TRICHLOROFLUOROMETHANE	ND 0.02	"
VINYL CHLORIDE	ND 0.18	"

REVIEWED BY

Steve Furnish

DISTRIBUTION: Original and Pink copies accompany sample shipment to laboratory. Pink copy retained by laboratory. Yellow copy retained by sampler.

DRILLING CONTRACT

RIG NO.

WELL CONSTRUCTION PERMIT NO.

1. WELL LOCATION: (Draw a sketch of the location on back of form)

Nearest Town RaefordCounty: HokeHighway Equip. yardQuadrangle No. 11-46, 2-62. OWNER: D.G.W.3. ADDRESS: Raleigh, N.C.4. TOPOGRAPHY: draw, valley, slope, hilltop, flat5. USE OF WELL: Observation DATE: 1-14-72

6. DOES THIS WELL REPLACE AN EXISTING WELL?

7. TOTAL DEPTH: 248' RIG TYPE OR METHOD: mill8. FORMATION SAMPLES COLLECTED: ☐ YES No. of Bags

9. CASING:

From	Depth	ft.	Inside Diam.	Well thick or weight / ft.	Type
0	62		4		mill
62	6		2 1/2		" "
101	111		2 1/2		" "

10. GROUT: Depth From 0 to 27 ft Material cement Method Hydraulic11. SCREEN: Depth From 62 to 67 ft Diam. 2 3/4 Type and Opening 20 G. Grr.2. GRAVEL: Depth From to ft. Size Material13. WATER ZONES (depth): 60-70', 94-103'14. STATIC WATER LEVEL: 43.45 ft. above below top of casing
Casing is 75 ft. above land surface. ELEV.

DATE MEASURED:

15. YIELD (gpm): 30-40 METHOD OF TESTING: air lift15. PUMPING WATER LEVEL: ft. after hours
at gpm.17. CHLORINATION: Type Amount18. WATER QUALITY: TEMPERATURE (°F)

19. PERMANENT PUMP: (Draw a sketch of well head on back of form)

Date Installed Type MakeCapacity (gpm) HPIntake Depth Airline Depth

20. HAVE YOU INFORMED THE WELL OWNER OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS?

21. REMARKS:

I do hereby certify that this well record is true and exact.

Oscar Howard

SIGNATURE OF CONTRACTOR OR AGENT DATE

DRILLING LOG		
DEPTH		FORMATION DESCRIPTION
FROM	TO	
		3 1/4 59 30
		29 14 40
		3160: 274.7
		Never Pumped
		Starting Date
		1/14/72
		275.77
		248
		-27.77

MINA
WATER & AIR RESOURCES
GROUND WATER

LITHOLOGIC LOG

Well No.: Field U 46, E-6

Log by: Oscar Howard Date 1-6-72 County Hoke

Office: _____

Location, Town Raford, Hwy. C Equip. yard

USGS: _____

Owner: D.G.W. Drillers: Oscar Howard Date Drilled 1-6-72

Depth 248 ft.; Diam. 4 in.; Cased to _____ ft.; Elev. _____ ft. above HSL

Cuttings yes Elec. log yes (gamma log) yes

Description	Depth (feet)		Thickness (feet)
	from	to	
Red clay with sand and some rocks soft	0	10	
clay-red-orange - pink with sand & brown clay soft	10	20	
clay- red orange - pink white sand streaks soft	20	30	
clay-red-orange - pink white sand streaks soft	30	40	
Orange sand with white clay soft	40	51	
White clay with sand (m.s.)	51	60	
Orange sand with clay white lenses (m.s.) <i>Screen 62.67</i>	60	70	
Orange clay with some sand streaks (m)	70	80	
Orange and white clay with sand streaks (m)	80	90	
" " " " " " " (m) <i>Screen 96.101</i>	90	100	
" " " " " " " (m)	100	110	
" " " " " " " "	110	120	
Yellow sand with gray clay (m)	120	130	
Yellow sand with gray clay layers (m)	130	140	
gray clay with sand and some red clay (m)	140	150	
gray clay with red clay and sand (m)	150	160	
various colors clay with sand lenses (M)	160	170	
" " " " " " " "	170	180	
" " " " " " " "	180	190	
" " " " " " " "	190	200	
" " " " " " " "	200	210	
" " " " " " " "	210	220	
" " " " " " " "	220	230	
Various colors clay with streaks (hard at 238)	230	240	
green clay; very hard	240	248	

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FAYETTEVILLE 19 MI.
FENIX 11 MI. 12°30"

